Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.
Published by McGraw Publishing Company, Inc.

Vol. 64 NEW YORK, SATURDAY, DECEMBER 26, 1914 No. 26

National Joint Line Committee

Some highly important work involving the healthy co-operation of practically all of the national associations interested in the subject has been undertaken by the national joint committee on overhead and underground line construction, the formation of which is recorded elsewhere in this issue. Being made up of the members of the separate committees dealing with this subject appointed by the dozen or so associations co-operating in the undertaking, it can safely be predicted that the national joint committee will serve to prevent duplication of work by the different committees, thereby minimizing the total labor involved, and to insure uniformity in the specifications adopted by the various associations, thereby avoiding all unnecessary conflicts. Its most effective efforts for the immediate future can be exerted in rearranging and redrafting existing specifications and formulating new specifications where none now exist. Doubtless the committee will be looked upon more and more as the court of last resort in the formulation and interpretation of specifications, and as such it should receive the hearty support of all interests concerned.

Co-operation of Stockholders

An impressive co-operative movement by stockholders to speak for the Cincinnati Gas & Electric Company has been started. Thirty-three stockholders, acting as a committee, are asking all stockholders of the company to organize for an impartial hearing and fair rates. If the real co-operation of stockholders can be secured, the possibilities of such a movement are great. If the committee can overcome reluctance of individuals to reveal their property interests, it will have over 8000 men and women to call upon. This is not so large a total as the number of the consumers served, but it is composed of persons who will command a hearing. City officials have dealt so long with impersonal corporations that when they find that their friends and neighbors are a live part of the public utilities they may modify their views. For the protection of the rate of return and the principal of the investment stockholders look primarily to the officials of the companies. It is part of what company officials are paid to do. They are, however, only the representatives of the real individuals whose money is risked. They cannot talk as effectively or with as keen a feeling of anxiety and as much earnest determination for a "square deal" as 8000 persons, acting as a unit, can do. The entrance of Cincinnati stockholders into the electrical rate case is an example that we hope to see followed in other companies at critical times.

The Use of Statistics

The use of statistics as a means of giving the public information about affairs was discussed at the recent meeting of the American Statistical Association. If they can be used truthfully and so intelligently as to be understood easily, statistics have an important place in public policy matters. If they cannot be so used as to be perfectly clear to the public, they are worse than useless. When two speakers cite, for instance, the experience of the same municipally owned and operated plant, one as an argument in favor of and the other as an argument against public ownership and operation, it is perfectly clear to the listening public that one or the other is either innocently or wilfully misrepresenting the real situation. Well-informed speakers have referred time and again to the 3-cent electric-railway fare prevailing in Cleveland without explanation of the fact that 1 cent is charged for transfers, and that, to produce this fare, the city forced a valuation under which stockholders lost 45 per cent of their stock. Similarly, public officials have spoken alluringly of the halfpenny fares in Glasgow without mention of the fact that only a limited distance could be traveled for this sum. These are points of misrepresentation which have come from proponents of public ownership. There are doubtless instances in which private-plant representatives have made like failures to tell all the facts fairly. Until statistics are tested and ready to stand public examination and questioning it is idle to offer them and to expect wholesome results to follow.

Co-operation in Foreign Trade

In an article in *The Americas*, the magazine of the National City Bank of New York, Mr. John D. Ryan, president of the Amalgamated Copper Company, argues for legislation permitting combinations of manufacturers on matters of export trade. He points out that in normal times England permits combinations in both foreign and domestic trade which our laws forbid; that France encourages combinations, and that Germany actively fosters and sometimes compels them. The chief competitors of our manufacturers are actively aided in this respect by their governments. Our government is not only not active in aid or even passive in acceptance of conditions that promote trade but is hostile toward combinations. No earnest attempt has ever been made to explain to the public the difference between combinations on domestic business and combinations on foreign business. If such an attempt had been made, the public would know that combinations on foreign business need not affect prices or practices for

domestic consumers but would increase our foreign trade and thereby help to steady business and to reduce the fluctuations between heavy and light demand. The recommendation of Mr. Ryan is that the law be defined. Business men have had no decision on the question of their right under the Sherman law to form combinations among competitors to handle export trade. The removal of this great handicap would be a decided stimulus to foreign trade at a time when conditions demand that oversea markets shall receive attention.

Photometry of Gas-Filled Lamps

In this issue appears an article by Messrs. G. W. Middlekauff and J. F. Skogland dealing with the curious phenomena observed in attempting to photometer gas-filled tungsten-filament lamps. The subject was discussed by Dr. C. H. Sharp before the New York Section of the Illuminating Engineering Society on Nov. 12, 1914. From Dr. Sharp's experiments it appeared that some very singular effects were observable in attempting to determine the mean horizontal candle-power by rotation of the gas-filled lamp. The present authors have investigated the subject in an elaborate and systematic manner and have discovered certain relations in the phenomena observed, which, however, are not such as to afford great comfort to the photometrist. In the first place, the variations in horizontal candle-power with the new lamps are so great that it is necessary to use accessory mirrors in order to eliminate the very great flicker. The distribution of light around the ordinary tungsten lamp is so nearly uniform that a low speed of rotation suffices for obtaining the proper value for the mean horizontal candle-power, which does not materially vary whether the lamp is used with its tip up or tip down. In the nitrogen-filled lamps the filaments are not mounted symmetrically about any axis whatever, with the result that not only is there a marked variation around the vertical axis but the lamp behaves differently when used with the tip up or the tip down, not only as regards the candle-power but with respect to the current. Moreover, when the speed of rotation is varied the current and the candle-power vary with the speed, in opposite directions, and the change is not the same when the lamps are used with the tip down as when they are used with the tip up.

The changes in candle-power are not negligible by any means, a difference as great as 14 per cent in the candle-power of the same lamp operated at constant voltage having been observed by the authors when varying the speed of rotation and the position of the lamp. They have investigated the facts sufficiently to discover practical methods of minimizing the difficulties, but the residual troubles are quite sufficient to be discouraging when one is absolutely driven to make a determination of the mean horizontal candle-power—a quantity of little importance in the particular class of lamp under discussion.

The results before us establish as a conviction what we held as an opinion when Dr. Sharp's paper appeared, that there is only one proper way of dealing with these lamps, namely, to integrate their total light flux in a sphere photometer. The value thus determined well defines the properties of the lamp as an illuminant and defines it in a simple scientific way. There is really very little excuse for going to any trouble to secure the mean horizontal value of the candle-power, which is a quantity of no particular significance after it is obtained, especially since it is the average of large variations in individual directions. If a measurement of candle-power variation in azimuth has any significance whatever, it is the variation that is important and not the fictitious mean value, which would become worth considering only in case the lamp were to be used while rotating. More and more, lamps are likely to be rated in lumens or in mean spherical candles. Moreover, gas-filled lamps, especially in the larger sizes, will be practically always used in diffusing globes which so change the space distribution of the candle-power that a mean horizontal measurement of the candle-power of the bare lamp represents largely useless data. It is most instructive to bring out clearly the peculiarities of the gas-filled lamps, and if the difficulties set forth can discourage attempts at a very troublesome and valueless kind of determination the labor of the investigators will have been remarkably well spent.

Incandescent Search-Lanterns

One of the notable gains in the introduction of the gas-filled incandescent lamp is its easy applicability to search-lamp practice, an advantage which ought to be felt in the progress of the present war. Until very recently it has been extremely difficult to obtain a powerful concentrated search-lamp except by use of the arc, but thanks to the introduction of the gas-filled lamp with a thick and comparatively stable filament, it is feasible to produce a medium power search-lamp extremely convenient to operate and taking relatively little energy. Considerable headway has already been made in the production of such lamps giving from 1000 to 2000 actual candle-power. The amount of electrical power required is so small that the whole equipment can conveniently be mounted on an automobile of moderate size or in case of need carried for considerable distances by men or horses.

A beam of light intense enough to detect the movement of hostile forces at 2000 yd. should be of great value, particularly when the apparatus is light enough to be readily shifted about in the trenches so that it may reappear in a different spot long before hostile artillery is able to get its range. Night attacks seem to be especially frequent, and sufficient light to disclose them even at a distance of a few hundred yards gives a chance for action in a period long enough to insure a repulse. Such search-lamps ought to be particularly valuable in repelling airship attacks, since their range is certainly adequate, except in very thick weather when airships themselves are likely to go astray, to pick up an object the size of a Zeppelin at any height attain-

able by such craft. With an incandescent search-lamp mounted on a fast automobile and followed by another with machine guns it ought to be possible to keep an airship once detected under fire for a long period. For many such military uses the incandescent search-lamp seems peculiarly fitted, and it will be rather surprising if it does not come into considerable use.

Electro-Dynamic Stresses

In a paper read before the British Institution of Electrical Engineers, abstracted in the current issue, Mr. P. V. Hunter brought to the front a subject too often neglected, namely, the electro-dynamic strains attributable to the mutual effect of the magnetic fields and the conductors. One learns of this in theory at a very early stage of his electrical education, but actual experience with heavy currents is necessary to afford an adequate conception of the genuineness of the phenomena. Of course, the familiar example of these stresses is in the end windings of turbo-alternators where the necessary bracing has required a good deal of study and experiment. Mr. Hunter calls attention particularly to the heavy mechanical stresses occurring in transformers, stresses great enough to cause serious danger. He expresses the opinion that a majority of the transformers of present-day manufacture are inadequately protected against the mechanical stress of short-circuits. To be sure, some protection is afforded by the fact that the voltage of the generator is apt to decrease sufficiently during short-circuit to protect the transformers, but the danger multiplies as the generating system and generating units become larger.

Seemingly a large station has the advantage over a small one, yet it is a serious question whether, all things considered, there is not really a limiting size—a size beyond which exceptional precautions must be taken against those dangers which are proportional to the output. It is a familiar fact that the switchboard costs of a large station are enormously greater relatively than in the case of a small station, owing to the large amount of the switching apparatus, the complications introduced by feeder connections and the structural requirements in the station itself due to the great mass of switch gear and protecting apparatus which must be safely housed. In fact, a very interesting investigation might be made of these dimensional elements, one group of which Mr. Hunter brings to the front. His general view is that it is desirable as far as possible to protect against the mechanical stresses by sound construction, considering the use of reactors and various protective devices as auxiliary rather than primary. The reactance of generators he considers an element of safety to be depended on in preference to external reactors. Advantage can be taken of step-up transformers directly connected to the generator terminals and serving by their reactance greatly to lessen the danger of short-circuits.

There seems to be no good reason why in designing a station for high-voltage output the generator and transformer should not be considered a unit instead of separate devices each of which must be elaborately protected against the other and provided with intricate means for shifting the load here, there and everywhere in the station. One does not insist upon facilities for driving any particular generator in a large station from any one of the steam turbines that are in use; it is sufficient if a unit be available when needed. The turbine, the generator and the transformers form just as logical a unit as does the ordinary turbo-generator. If considered in the light of this fact, station construction can be greatly simplified.

Lighting of Country Roads

It is, of course, impracticable to extend far out beyond the thickly settled territory the kind of street lighting customarily employed in cities and towns. It is a fundamental principle in street lighting to adjust as far as may be the amount of lighting to the traffic needs of a community, and this as a rule implies very thorough lighting in the chief streets and much less toward the suburbs, where the requirements are different. However, at the present time traffic conditions are quite different from what they were ten years ago. By reason of the greatly increased and rapidly growing use of automobiles there has been a complete readjustment of traffic density with respect to both direction and time. Out of every city run a few streets which finally merge into roads through rural districts, leading in some definite direction to attract traffic, and it is highly desirable that such roads should be lighted, not for the purpose of surface illumination, which the headlamps of the vehicles themselves supply, but for a sufficient marking of the way to facilitate the passage of vehicles in general. Anywhere within the region lighted at all automobiles can run with comparative safety and ease in case of an accident to the main headlamps; horse-drawn vehicles can find the way readily enough in very unfavorable weather, and the progress of pedestrians is equally facilitated.

Under present conditions it is desirable to extend the lighting of towns along the principal roads, even if the lamps are small and widely spaced, in order better to point the way and facilitate the progress of all travel. The difference between walking or riding along an entirely dark road and along one even very badly lighted is astonishingly great. Even 40-watt or 50-watt lamps spaced twenty to the mile are a great deal better than nothing. From the standpoint of illumination judged by foot-candles such lighting as we here describe is negligible, but it actually does mark the route to a very material extent. If the councils of the smaller towns would co-operate to extend systematically the lighting along the chief roads, even on the most economical scale, they would confer a considerable benefit on the traveling public. Low-candle-power lamps spaced even at ten to the mile are not to be despised on a dark road. The cost of such road lighting is very small, and efforts should be made systematically to extend it from town to town over all chief roads.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Plans of National Joint Committee on Line Construction

For the purpose of completing its organization and laying out its working program the national joint committee on overhead and underground line construction held a meeting at the headquarters of the American Institute of Electrical Engineers on Dec. 16. According to present plans, this committee will prepare specifications on suggested practices, or perhaps recommend modifications of existing regulations relating to the following subjects: (1) Underground and undergrade crossings; (2) crossings of electric wires over electric-railway tracks; (3) crossings of trolley contact wires; (4) overhead crossings of wires or cables of telegraph, telephone, signal and other circuits of similar character over steam-railroad rights-of-way, track or lines of wires of the same classes; (5) overhead crossings of electric light and power lines; (6) parallel lines.

Specifications covering subject No. 4 already prepared by an earlier joint committee representing various interests are now being considered for adoption by the national joint committee. Subject No. 5 has been covered by the standard specifications adopted by the American Electric Railway Engineering Association. The other subjects are new, and specifications relating thereto will have to be prepared by the committee, which is enlisting the co-operation of all persons and associations interested in any way in line construction.

The national joint committee is made up of official delegates and alternates from the following organizations: American Railway Association, American Railway Engineering Association, Railway Signal Association, Association of Railway Telegraph Superintendents, National Electric Light Association, American Electric Railway Engineering Association, American Institute of Electrical Engineers, American Electric Railway Association, American Telephone & Telegraph Company, United States Bureau of Standards, Independent Telephone Association of America, Western Union Telegraph Company, and Postal Telegraph Company.

Mr. Farley Osgood, Newark, N. J., is chairman, and Mr. G. W. Palmer, Jr., Boston, is vice-chairman of the committee. The secretary is Mr. R. D. Coombs, 30 Church Street, New York, and Mr. W. H. Feller, 759 Broad Street, Newark, N. J., is the assistant secretary.

Meeting of Oregon Electrical Contractors' Association

That contracts for electrical wiring and equipment should be let separately and not included in a lump contract for the building was the opinion of the members of the Oregon Electrical Contractors' Association, which held its annual convention in Albany, Ore., Dec. 9. Before the convention adjourned a resolution was adopted urging uniform effort to make separate contracts for electrical work the rule in Oregon. Officers were elected as follows: President, Mr. John Tomlinson, of Portland; first vice-president, Mr. Harry Sroufe, of Portland; second vice-president, Mr. Joseph H. Ralston, of Albany; third vice-president, Mr. Lester Armitage, of Corvallis; secretary-treasurer, Mr. J. W. Oberender, of Portland. Messrs. S. C. Jagger and F. L. Green, both of Portland, were chosen to serve with the officers as an executive committee. Papers were presented as follows: "The Relation of the Contractor and Dealer to the Central Station," by Mr. J. L. White, manager of the Oregon Power Company, of Albany; "Credits and Collections," by Mr. P. A. Young, of S. E. Young & Son, of Albany; "The Jobber and the Contractor," by Mr. John F. Ryan, of the Portland office of the Western Electric Company; "The Central Station," by Mr. A. C. McMicken, of the Portland Railway, Light & Power Company. Approximately 100 delegates were in attendance.

Accident to Cleveland Distribution System

A short-circuit of unknown origin crippled the direct-current distribution system of the Cleveland Electric Illuminating Company at about 3 a. m. on the morning of Dec. 16. It was necessary to shut down the Canal Road station and the East Seventeenth Street substation to control the situation. As soon as this was done steps were taken to cut the system in two by opening circuits at various junction boxes and, this accomplished, the East Seventeenth Street station was started up about 9.30 a. m., restoring service to the eastern portion of the business district. Meanwhile an abandoned station on East Third Street was tuned up, and several circuits were tied in there.

Temporary 1,000,000-circ. mil weatherproof cables were run overhead, and by the morning of Dec. 17 the bulk of the business district had energy, but the use of it was restricted until more cables could be installed. By the morning of Dec. 18 all parts of the district were supplied with energy as usual.

Investments in Latin America

If American manufacturers are to acquire and retain the trade of the Latin republics of the southern part of this hemisphere, they should encourage the investment of American capital in those countries and the establishment of an American merchant marine, declared Mr. Edward N. Hurley, president of the Illinois Manufacturers' Association and the Hurley Machine Company, Chicago, in an address before the Chicago Traffic Club on Dec. 18.

Several fine boats flying the United States flag now sail each month from New York to Brazil and Argentina, but the bulk of the South American traffic is carried in British bottoms. American investments in foreign countries should be classed as domestic investments in many essential respects, for, as a result, declared Mr. Hurley, the foreign business of American manufacturers can be increased to a point where, except for labor and supplies paid for locally, practically all of the money invested will actually remain in the United States to purchase American-made products.

Proposal for Texas Utilities Commission

If the Texas Legislature enacts at its next session the bill which has been drafted by State Senator A. C. Robbins, of Athens, there will be created a public utilities and corporation commission. The measure places all private and municipal public service plants under control of the proposed commission, to which is also given authority to inquire into the business of all corporations of whatever character. The bill provides for a commission of three members.

Urge Need of More Publicity for the Electric Truck

At a meeting of the Chicago Section, E. V. A., Dec. 8, Chairman McDowell emphasized the need for more publicity for the electric truck, to reinforce the efforts of the manufacturers' salesmen. He suggested that some co-operative campaign be undertaken with the help of the local central station, and that newspaper space be used to reach the owners of the 90,000 horses in Chicago and vicinity. His suggestion met with the approval of the section, although it was pointed out by Mr. G. B. Foster that the publicity problem should be first analyzed to discover whether some more direct means of publicity might not be more economical for reaching prospective truck users. The discussion then turned on the need of dependable truck operating data. Figures collected by the N. E. L. A. and the *Electrical World* were referred to by several speakers. The compilation of truck operating costs based on mileage as well as on day's service was recommended, and the fallacy of too free generalizing in averages was pointed out.

Rate Agreement Reached at Houston, Tex.

Under the new schedule of rates agreed upon between the City Council of Houston, Tex., and the Houston Lighting & Power Company, the primary charge for lighting service is 9 cents per kw-hr. and the secondary charge 5 cents per kw-hr., the minimum monthly bill being fixed at 50 cents. For motor service there is established a fixed charge of 25 cents per month per hp of rating, plus energy charges of 5 cents per kw-hr. primary and 2.5 cents per kw-hr. secondary. Residence customers may obtain the motor rate for electric cooking, provided that a separate meter is installed, the minimum charge on which is 50 cents per month. All bills for lighting are subject to a discount of 10 per cent if paid within ten days. Monthly flat rates are also fixed for ceiling fans operated during daylight hours and twenty-four hours per day. By action of the Council on Nov. 28 the new rates were made retroactive and effective as of April 1, 1914.

Reply of Cincinnati Company to King Report

Mr. W. W. Freeman, president of the Union Gas & Electric Company, Cincinnati, Ohio, has submitted to the Cincinnati City Council the reply of his company to the valuation and rate-revision reports prepared by Mr. Arthur C. King, of Chicago (abstracted in these columns on Nov. 28). In the reply Mr. Freeman points out that the principle of rate-making employed by Mr. King ignores both the capitalization and the actual money invested in the property and undertakes instead to determine present value on a reproduction basis.

"It must be obvious," declares President Freeman, "that any figures thus obtained are nothing more than engineering opinions, however carefully formed, and that grave injustice and injury to the company will be done unless the estimated values include every piece of property and every element of true value. Without admitting that this rate theory is logical in reasoning or fair in results, when fairly applied to the Cincinnati situation, such method proves that the present electric rates of the company are grossly inadequate to yield a reasonable rate of return upon the fair value of the electrical property."

Mr. Freeman points out that the electric rates of the company could be increased by almost 23 per cent without producing earnings in excess of a reasonable rate of return upon the present electrical property. It is not the intention or desire of the company to increase its rates for electric service. What the company prefers, and proposes to do, is to develop its business through low rates to an extent which will, if possible, produce business in sufficient bulk to offset the present inadequate revenue. The present rates in Cincinnati, the reply adds, are unusually low in comparison with those charged in other corresponding cities.

Welfare Plans of Westinghouse Company

The Westinghouse Electric & Manufacturing Company has issued a preliminary statement regarding its sickness and accident relief, accident compensation and service pensions, on which its officers have been working for over a year. The plan will be put into effect on Jan. 1.

Relief Department

The privileges of the relief department are open to every employee, male or female, regardless of age, position or location, upon payment of small monthly dues. The company pays the expense of operation and maintenance of this department, the dues being reserved for the payment of benefits (proportioned to wages) for sickness and accident arising from causes other than employment. In the event of death the amount paid from the dues will be duplicated by the company, which will also meet any deficit that may arise. Benefits will continue as long as disability lasts, or until the age of seventy years, when pensions will be granted.

Accident Compensation Plan

An accident compensation fund is maintained entirely by the company for the benefit of all employees, male or female. This plan covers payment for disability due to accident, or for death resulting from accident while at work as an employee and makes provision for both total and partial disability. In case of total disability the company will pay as long as the disability lasts, even for life, two-thirds of the average wages received, and for partial disability, two-thirds of the reduction in the earning capacity of the employee, even though the employee should eventually leave its service. In case of death the company will immediately pay the dependents or next of kin $150 as a pension to the widow or dependent husband or children under sixteen years of age. Medical, surgical and hospital expenses under the direction of the company's medical officers will be paid during disability from such accidents.

Service Pensions

Employees shall be retired at the age of seventy years, and those who at the time of such retirement are members of the relief department and have completed at least twenty years of continuous service are to be granted a pension amounting to 1 per cent of the average monthly wages during the last ten years of employment for every year of continuous service, with a minimum of $20 per month and a maximum of $100 per month.

Upon the death of the pensioner one-half of the pension will be paid to the widow until remarriage, provided that marriage occurred at least ten years before the granting of the pension. For the support of each child under sixteen years of age, and for each wholly dependent grandchild under sixteen years of age, one-fourth of the pension will be paid until they reach the age of sixteen years. The president may at his discretion retire any employee between the ages of sixty and seventy years who has been in the service the required time, and he may increase any pension for specially meritorious service by 25 per cent, but not beyond the maximum pension of $100 per month. In states already having workmen's compensation laws, as New Jersey and Ohio, where the company also maintains plants, such laws may be substituted in whole or in part. Where the provisions of the Westinghouse plan are more liberal these will generally prevail.

Safety Medal to Commonwealth Edison Company

The Travelers' Insurance Company Gold Metal, awarded annually for the past five years to the employer instituting the best safety work for the protection of employees and the public, is this year given to the Commonwealth Edison Company of Chicago. The award was made by a committee of the American Museum of Safety, the result being announced at a luncheon at Delmonico's, New York, Dec. 17, during the week of the International Exposition of Safety and Sanitation, at which the Commonwealth Edison Company had an exhibit of photographs showing its safety work.

Hearing on Muscle Shoals Project

A hearing was held by the rivers and harbors committee of the House of Representatives in Washington on Dec. 12 on the proposal to improve the Tennessee River between Brown's Island and the Railroad Bridge below the city of Florence, Ala., the estimated cost of which is $18,701,000, of which it is proposed that the Muscle Shoals Hydro-Electric Power Company shall pay the major part.

Nearly 200 persons were at the hearing. Governor O'Neal of Alabama, Mr. C. H. Huston, of Chattanooga, Tenn., Speaker Carmichael of the Alabama House of Representatives and Mr. J. W. Worthington, representing the power company, were among the speakers. Mr. Worthington said that there is no demand for power from Muscle Shoals at present, and that the demand would have to be created by the establishment of plants for the manufacture of fertilizer by a process which takes nitrogen out of the air for use in the soil. Governor O'Neal said that the price of transportation would be reduced if the Tennessee River were made navigable, and that if the cotton growers could obtain the fertilizer they would save millions of dollars annually expended for sodium nitrate sent from Chile.

Franchise Value Recognized in Passaic Gas Case

The Court of Errors and Appeals of New Jersey has rendered an opinion in the Passaic gas case. It reverses the judgment of the Supreme Court and thus sets aside the order of the Board of Public Utility Commissioners making a rate of 90 cents for gas for the Public Service Gas Company in the Passaic district. The court holds that in the valuation of the property an allowance should have been made for franchise value. The court was divided on the decision, the vote on which stood six to four, with six members not voting.

The decision says: "If, as we think is the law, substantial allowance should be made for the franchise of a gas plant if taken for public use, and the value of such franchise paid in money to the owners thereof, we fail to see why, so long as the plant and franchise possessing that value for sale or condemnation are held and operated by the owners, the latter should not be entitled to a reasonable income on all elements of their property, including the franchise, in the absence of any charter reservation or contract to the contrary."

Central-Station Service for San Diego Exposition

A new 4000-kw steam-turbine set is being installed by the San Diego (Cal.) Consolidated Gas & Electric Company to supply the electrical service for the Panama-California Exposition, which will open at San Diego on New Year's Eve. The exposition lighting and motor load will total 2500 kw and is to be supplied exclusively by the local central-station company. Three 1000-kw transformers are also to be installed for the exposition service. This special equipment, it is promised, will be ready before the opening ceremonies.

Stockholders in Cincinnati Rate Case

Stockholders of the Cincinnati Gas & Electric Company have organized a committee of thirty-three members to do all that lies in their power to protect the interests of the company in the pending rate negotiations with the City Council. They have issued circulars, booklets, postal-card pledges and Vol. 1, No. 1, of the *Stockholders' Herald*. The circular letter asking the support of other stockholders says in part:

"Are you sufficiently interested in preserving your stock in the Cincinnati Gas & Electric Company to join with the other stockholders of the company in forming an organization that will be capable of meeting a situation that has arisen?

"The company has pending before the City Council an application for a renewal of its rates for supplying electricity. A well-defined and powerful propaganda seeks to impose unfair rates on the company with the ultimate end of destroying a large part of the value of the company's property.

"The undersigned stockholders are of the opinion that all stockholders should unite and take all steps necessary to procure for the company an impartial hearing and a fair rate for its service. This can be done only by the real owners of the property, namely, the stockholders, encouraging a movement that will secure for the company such rates as will be fair and will be a just return on the money invested in the company. Stockholders acting together can exercise a powerful influence upon public opinion which will offset the attacks of professional agitators who are more interested in their own selfish advancement than in the real progress of the city.

"In the next few weeks hearings will be held by the City Council relative to the electric-lighting question, and we believe it is the duty of stockholders to be present at these meetings. We also request, in justice to yourself and the company, that you do not hesitate to express publicly your opinion on this question."

The booklet giving facts and figures says that there is a lack of understanding that public and company interests are identical and that the millions invested in the company by citizens are entitled to encouragement

and a feeling of safety instead of attack and fear of confiscation. Another card quotes from a table of rates in various cities contained in the report made recently to the city by Mr. Arthur C. King, which shows that maximum rates in Cincinnati are decidedly low in comparison with other corresponding cities.

The *Stockholders' Herald*, under the caption "Let There Be Light," expresses its aims. The stockholders of the company number above 8000, more than one-half of whom are women. Of this large number only 15 per cent own in excess of fifty shares. Fully 25 per cent of the stockholders own between one and five shares.

CHEAP WIRING METHODS DISCUSSED

Electrical Manufacturers, Jobbers and Contractors Urge Delay in the Approval by the Underwriters of Grounded Concentric Wiring

Judging by the opinions expressed at a meeting of electrical interests made up of electrical manufacturers, jobbers, contractors, etc., at the Biltmore Hotel, New York City, Dec. 22, the electrical industry is not quite ready for the change embodied in the proposal of the National Electric Light Association's committee on the wiring of existing buildings to have the Underwriters at their March meeting permit the use of a grounded concentric wire for interior work. While it was felt that the lighting companies have much to gain by such a change, the other branches of the industry fear that any scheme whereby construction is cheapened is fraught with danger and should not be passed for use by the National Electrical Code except after a most searching analysis of every detail and after giving manufacturers a chance to adjust themselves to the change.

Mr. George A. Cragin, of the American Steel & Wire Company, Worcester, Mass., was unanimously elected chairman and Mr. C. E. Corrigan, of the National Metal Molding Company, Pittsburgh, vice-chairman of the meeting. By unanimous consent also Mr. George H. Duffield, secretary of the National Electrical Contractors' Association, acted as secretary. The general object of the conference was explained by Mr. Charles L. Eidlitz, of the Metropolitan Electric Manufacturing Company, Long Island City.

Mr. Eidlitz gave the personnel of the committee appointed for the purpose of investigating a new method of wiring as outlined in past issues of the *Electrical World* and described at some length the Stannos wire used in England, for permission to use which in this country, he said, the Underwriters are now being importuned by the lighting companies. Without professing to know all of the details of the wiring system, Mr. Eidlitz said that offhand it would appear as though the manufacturers of wires, of sockets, of cut-outs, of fittings, of switches, of conduit and of other kinds of materials used in interior wiring work would be seriously affected by the proposed change.

Mr. Wallace Clarke, of the General Electric Company, explained the position of that company in the matter. He showed and described the Stannos wire used in England and also the cheaper Kuhlos wire used in Germany. The former has a soldered sheath outside of the insulated wire, whereas in the German system the sheath is simply crimped together. The patent situation with reference to the wire, he said, was such that any manufacturer in this country was free to manufacture it.

Mr. J. R. Strong, of the Tucker Electrical Construction Company, a past-president of the National Electrical Contractors' Association and a member of the committee to which the matter of the concentric wire was submitted, said that the use of the concentric wire had not been approved by the Underwriters, had not been considered by the Underwriters in fact, and had been merely placed before a sub-committee appointed by the chairman of the electrical committee of the National Fire Protective Association and that that sub-committee had not yet made up its mind on the proposition.

Mr. H. B. Crouse, president of the Crouse-Hinds Company, commented on the fact that the manufacturers of America have invested a great deal of money, time and energy in working with the Underwriters toward the accomplishment of high-grade installations. Such being the case, the manufacturers should have every consideration and be given sufficient time to readjust their business if conditions are to change. For that purpose Mr. Crouse moved the appointment of a thoroughly representative committee to go into the matter with the sub-committee of the Underwriters. This suggestion was seconded by Mr. C. E. Corrigan. The general committee appointed was made up as follows: Mr. Charles L. Eidlitz, chairman; representing the wire manufacturers, Messrs. W. A. Connor of the Standard Underground Cable Company, Perth Amboy, N. J., R. K. Sheppard of the B. F. Goodrich Company, Akron, Ohio, and George A. Cragin of the American Steel & Wire Company, Worcester, Mass.; representing the conduit manufacturers, Messrs. C. E. Corrigan of the National Metal Moulding Company, Pittsburgh, Pa., F. C. Hodkinson of the Safety-Armorite Conduit Company, Pittsburgh, and L. J. Campbell of the Western Conduit Company, Youngstown, Ohio; representing fitting manufacturers, Mr. H. B. Crouse of the Crouse-Hinds Company, Syracuse, N. Y., W. T. Pringle of the Pringle Electric Manufacturing Company, Philadelphia, and A. W. Berresford of the Cutler-Hammer Company, Milwaukee, Wis.; representing porcelain manufacturers, Mr. Herbert Sinclair of the Star Porcelain Company, Trenton, N. J., and J. E. Way of R. Thomas Sons Company, New York City; representing the jobbers, Mr. Frank S. Price of the Pettingell-Andrews Company, Boston, E. W. Rockafellow of the Western Electric Company, New York, and W. W. Low of the Electric Appliance Company, Chicago; representing the electrical contractors, Mr. Ernest Freeman of the Freeman-Sweet Company, Chicago, Mr. John R. Galloway of Washington, D. C., and John Livingstone of the J. Livingstone Company, New York City; representing electrical engineers, Mr. Gano Dunn of J. G. White & Company, New York City; representing fixture manufacturers, Mr. Louis McCarthy of the Macallen Company, Boston, Mass., and R. B. Benjamin of the Benjamin Electric Manufacturing Company, Chicago; representing manufacturers of conduit boxes, Mr. R. B. Corey of the Pratt-Chuck Company, New York City; representing socket manufacturers, Mr. W. C. Bryant of the Bryant Electric Company, Bridgeport, Conn.; representing fuse manufacturers, Mr. E. B. Hatch of the Johns-Pratt Company, Hartford, Mr. L. W. Downes of the D. & W. Fuse Company, Providence, and Bryson S. Horton of the Detroit Fuse & Manufacturing Company, Detroit, Mich.

The committee was instructed to make a thorough investigation of the proposed system and to report to a meeting to be called on Feb. 9. In the meantime the committee is also to confer with the sub-committee of the National Fire Protection Association and endeavor to secure a postponement of any action on the part of that committee on the scheme of concentric wiring for the present at least. A special committee was also appointed consisting of Messrs. R. K. Sheppard, chairman, H. B. Crouse, C. E. Corrigan, E. Freeman and F. S. Price.

MR. BRITTON ON WATER-POWER BILL

Vice-President of Pacific Gas & Electric Company Outlines Conditions That Will Encourage Hydroelectric Development

At the hearing on the water-power bill before the committee on public lands of the United States Senate at Washington on Dec. 11 an extended statement was made by Mr. John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company.

Mr. Britton has been in the public utility business for over forty years. He discussed the bill with respect more to practical operation than from any other point of view. Mr. Britton spoke of the beginning of water-power development in 1890. The beginning of the present Pacific Gas & Electric Company system was in a small 3000-hp plant; now the output is practically 200,000 hp. That development was made possible by rates that were comparable with costs of coal energy in the earlier days and subsequently energy from oil. California has been developed to its present industrial importance entirely through the development of hydroelectric plants and the resultant cheapening of power. It is as prosperous as it is by reason of cheap hydroelectric power. Rates in California for lighting, heating and motor service are lower by practically 50 per cent than in any other state with which Mr. Britton is familiar and lower by far than anywhere in the Eastern States except perhaps in instances governed by the Niagara development.

Hydroelectric and Steam Energy

In the judgment of Mr. Britton, California has the very best public service commission that ever was appointed. Notwithstanding that regulation was developed, the companies in the entire State, from the time they first began the introduction of electrical energy, reduced their rates as business increased and as returns warranted without regulation, except in the congested sections such as in San Francisco. Mr. Britton prophesied that the time is not very far distant when the cost of hydroelectric generation and transmission to central points and the cost of steam generation and transmission will meet and cross, and that by reason of cheaper fuels owners of plants in a great many states will reduce the point of economical steam generation by locating where water can be obtained for condensation purposes, and steam will become a cheaper prime mover for the generation of electrical energy than will the falling waters of the streams.

The Pacific Gas & Electric Company courts regulation. There was not a public utility man in California who did not welcome the laws existing at present. In the Antioch and San José cases the commission found that the corporation was entitled to receive 8 per cent upon the reproduction value of the property devoted to the service of the public. It found that the average rate for energy delivered to the substations in the district was practically 7.3 mills per kw-hr. Steam power had been generated and delivered practically under the same conditions for less money where the efficiency of great turbines has been utilized on a high load-factor.

Possible Injustice of Regulations

As an example of the great injustice that may be done by such regulations as are proposed by the bill under consideration, Mr. Britton referred to the development on the South Yuba River. The company owns in fee simple the lands surrounding Lake Spaulding and the lands and waters of the old Lake Spaulding, all the land involved in the aqueduct except a part of a quarter section of forest reserve land, and every other part of the development, including transmission lines, except a small portion from the power houses to the centers of distribution. At the upper end of the lake to be created by this large dam and the enlargement of the present lake were practically 28 acres of land cornering on the forest reserve which was to be submerged at certain contours following the height of the dam as raised. The Department of Agriculture demanded that the company take out a permit to cover all of its properties, including the right to regulate not only the power houses directly contingent to the Lake Spaulding development but also the ten power houses in the large system of the company, and that it abide by all the rules and regulations of the Department of Agriculture because in all of the development, involving over $60,000,000 of invested capital and the new development entailing an expenditure of finally over $10,000,000, there were the 28 acres of land that would be submerged ultimately. The water used out of this reservoir is for the purpose not only of the generation of power under regulation of the State commission but also for irrigation at the present time of over 20,000 acres of State land and possibly, after it has furnished power, of over 50,000 additional acres. The company protested, but was forced unfortunately to bring suit against the Secretary of Agriculture to determine whether he had any constitutional right to demand application for the permit. The suit is pending in the United States Circuit Court.

Mr. Britton said that the California Gas & Electric Corporation, which was the immediate predecessor in interest of the Pacific Gas & Electric Company, was organized in 1903. Prior to that time two or three other independent power companies, organized largely by the same class of men that controlled the California Gas & Electric Corporation, had been in operation. At no time during the life of the subordinate corporations and the Pacific Gas & Electric Company was any attempt made to enter into competition with existing companies. The property of the companies absorbed and now owned by the Pacific Gas & Electric Company was purchased at the fair values fixed by the owners. The company did not seek to exercise its monopoly unjustly or in any way illegally. Approximately 150 cities, towns, villages and settlements of different character are served by the company. About one-half of the energy is developed by water-power and one-half by steam. San Francisco is almost entirely dependent upon steam for energy. The cost of steam energy in San Francisco, generated and delivered to a substation for distribution, would be something less than 8 mills per kw-hr. Mr. Britton quoted President Eshleman of the Railroad Commission of California as effectually disputing in a telegram to Congressman Kent the statement that ownership and control in such a large extent of territory as is served by the company is any factor as a monopoly. The company entered the field as a pioneer, and it has developed it to the fullest extent, developed thousands and thousands of acres of land that had been arid by giving cheap energy for irrigation, encouraged manufacturers, attracted industries to the State that never would have gone without cheap energy, and developed the manufacture of cement by giving a rate for energy that made it possible to sell cement in competition with foreign and Eastern producers. Instead of being classed as a monopoly, it should be classed more as a philanthropist for what it did for the benefit of California. If the company had to use coal instead of cheap fuel oil, the steam plants could not be operated at so low a cost as the water-power plants.

Interlocking Directorates

Mr. Britton was asked if he had seen the diagram presented before the House of Representatives committee showing interlocking directorates of electrical com-

panies. He said that he had and that so far as it stated the relation as between individuals and the Pacific Gas & Electric Company it was accurate. The diagram called attention to the connection of Mr. Samuel Insull with the company as a director. In the appendix it mentions the holdings of Mr. Insull and quotes a statement from a newspaper to the effect that he had become the purchaser, together with a syndicate, of 40,000 shares of stock. So far as the records of the company show, that statement was untrue. Mr. Insull became interested in the company as a director when he bought approximately 10,000 shares of its stock as an investment. The company is controlled entirely by California men. It has $32,000,000 of common stock and $18,000,000 of preferred stock outstanding. In the Pacific Coast States there are 3976 stockholders out of a total of 5792, and they hold 234,751 shares. In the Middle States 65,000 shares are held, in the Eastern States 165,000, and in Europe 42,000. Of these totals, 1621 employees own $548,600 of preferred stock and consumers of the company own $1,325,000 of the preferred. In a campaign undertaken some time ago by the company preferred stock was sold to employees and consumers. The preferred stock was issued during the construction of the Lake Spaulding and South Yuba development. At that time bonds were not salable. The bonds authorized for the improvement by the Railroad Commission of California could not be sold, and money had to be borrowed wherever it could be found. The company borrowed $7,500,000 in New York City on short-time notes and unfortunately had to pay for it 10¾ per cent per annum. Among the large holders of the stock are: Mr. Frank G. Drum, the president, 17,765 shares; William P. Bonbright & Company, Inc., 15,604 shares; Pacific Lighting Corporation, 13,000 shares; Mr. L. J. Hart, 11,000 shares; Mr. Samuel Insull, 10,132 shares; Mr. J. C. Cebrian, 5392 shares; A. Iselin & Company, 8409 shares; Equities Securities Company, 7826 shares; Illuminating & Power Securities Company, 6500 shares, and Public Utilities Corporation, 5500 shares. The average holdings are about sixty shares per stockholder. The preferred stock was issued by order of the commission at 82½. After stockholders neglected to take the stock, employees and consumers and the general public of California were invited to subscribe.

Competition Now Prevented

Practically the entire remunerative field served by the company was covered also by competing companies prior to the creation of the Railroad Commission. Four companies operated in competition with the company in San Francisco and in and around Oakland at one time. That competition cut rates in some cases more than one-half and they have remained at the low figures. Competition existed even before hydroelectric energy was developed. As an example of competition which the commission is seeking to prevent, Mr. Britton cited the fact that the Great Western Power Company invaded the Sonoma Valley, where there are three towns of 3000 to 4000 population. The Pacific Gas & Electric Company had covered the entire territory and was serving every applicant. The commission at its first hearing decided that competition should be permitted, that the Pacific Gas & Electric Company was not giving the service that it should have given and had not met all demands for service. The company demurred but submitted to the ruling. At large expense the Great Western company built a distributing line in the valley and adjoining territory and began to give service. The reports of the first year showed that the total revenue of both companies was nearly equal to the revenue of the one that had occupied the field. There was also an additional investment involving hundreds of thousands of dollars that was not earning anything. For that reason commissions are recognizing the fact that regulation of monopoly is more beneficial to the capital invested, and eventually to the consumer, than is competition as it has been allowed to exist. The congested centers of the large cities, such as San Francisco and Los Angeles, were never dependent and could not be made dependent entirely upon hydroelectric transmission.

The Fifty-Year Permit Provision

Speaking particularly about the bill, Mr. Britton said that the provision limiting the term of permit to a period not longer than fifty years would prevent the financing of any future project of this character. When rights are liable to be terminated at the will and pleasure of the government there would be no means by which the proper investments made on behalf of an enterprise could be returned. If the term is certain and known, there is a possibility that provision may be made for the proper return of the capital investment. The period ought to be fifty years and thereafter until terminated through some action of the government in taking the property over for its own benefit for purely public purposes and not for the purpose of going into competition with other companies operating in the same field. The rights ought to be practically in perpetuity because if a company operating an investment of this character for fifty years under proper state regulation gives a service to the public that is high in class and reasonable in rates it ought to be permitted to continue unless the government requires for some public purpose to acquire the plant. The term ought not to be less than fifty years, because in the present progressive state of the science of electric distribution no man can say what will happen.

Progress of the Art

Plants that ten years ago were considered of the highest efficiency are to-day merely junk, and the progress of science is so uncertain that no one would want to put in anything to-day that might by the termination or cessation of the lease in a brief period of time be determined to have no value. Mr. Britton expressed the belief that there is not a plant in existence to-day that was in existence when steam generation of electrical energy was first started. A great many of the first water-power plants are to-day mere heaps of junk. If, as President Wilson said, the door can be unlocked and regulation provided that will prevent monopoly, Mr. Britton believes that the securities of companies will sell at very much higher figures; the higher the figures the less the public will have to pay finally for the properties. Mr. Britton also said that he did not favor the clause providing that the chief officer of the department under whose supervision lands may be shall have the right to determine whether or not they shall be used for the purpose contemplated. In his judgment the bill ought to set forth specifically the form of lease with all the conditions pertaining thereto. The clause which provides that at no time shall any lessee deliver to any one consumer electric energy in excess of 50 per cent of the total output Mr. Britton characterized as absurd. In the development of electric chemical processes the country will be dependent largely on the economical utilization of undeveloped water-powers. Recently Mr. Britton had a call from an engineer from Norway who asked for a rate on 100,000 hp or more so that a plant for the manufacture of the nitrates could be established in California. There are developments now under way in California at different points where it will be possible for the greater part of the output to be consumed by an industry of that character which uses the energy twenty-four hours a day and 365 days

in the year. The ultimate interests of consumers will be served by that arrangement. It will enable the plant to sell the remainder of its supply of energy at a very much lower rate.

Value of Electrochemical Process

The load-factor of the Pacific Gas & Electric Company has been built up from practically 12 per cent in 1903 to 70 per cent now. The electrochemical process which is being used so well now in Norway and is so greatly encouraged in that country and in Canada is going to be one of the saviors of hydroelectric power and the beginning of low rates for energy generated in that way, and will perhaps change the tendency Mr. Britton mentioned, so that hydroelectric energy will continue to be below steam energy in cost of production. Mr. Britton said that companies in Norway are able to make low rates because they have no aqueducts to build and their construction costs are therefore restricted. They get water on top of the hills and take advantage of natural falls. Without this advantage in construction there are undeveloped projects to-day in California where the minimum cost per horse-power will be reached. In the early days, where the development of hydroelectric energy was in small units of 1200 hp, necessarily the cost per unit was very much greater than it is to-day. Water-power cost in those early days about $300 per hp for installation. The Pacific Gas & Electric Company developed a plant not very long ago at a cost of $51 per hp, but that was in a case where the water pens were entirely elevated and there was a natural flow from a continuous body of water at Nevada City. Advantage was taken of that by the installation of a pipe line and power house. The cost will run between that low price and $150 or $200 per hp now. If a company wants to sell 75 or 90 per cent of its output to one consumer, it is in the interest of the consuming public that that should be permitted.

Mr. Britton objected on economic grounds to the clause relating to the physical combination of plants or lines. He spoke of the purchases of energy made by the Pacific company from other companies in California. The various plants are tied together, and it is wise from an economic standpoint that this should be so. If it had not been for this arrangement, some of the companies would have been without energy for their customers at times. With state regulation there is no reason why the companies should not be tied together for the protection of the service and the public.

Properties Inseparable

One section provides for the acquisition of the properties which may be dependent in whole or in part for their usefulness upon the continuance of the lease. There will be no part of the entire $60,000,000 of holdings of the Pacific Gas & Electric Company that would not be dependent in whole and in part upon the other parts. The company has ten power plants, no one of which by itself could supply the systems. The distribution systems are all tied in and are not separable. The rights to be granted over public lands of the United States should be guaranteed in absolute perpetuity, subject to such laws and regulations as will enforce proper conduct by the company. If the property is not supervised by the State commission, the United States then should have the right to appear. Mr. Britton expressed himself as personally favoring strongly a provision that a company of the character of the Pacific Gas & Electric Company should have the right to condemn United States land for its purposes as it can condemn State land in California for its purposes. If such land was condemned, the value of the land, even at the condemnation value, should not be taken into consideration in rate-making. "We think more of the question of our absolute tenure of the land in the service of the public," said Mr. Britton, "than we do of the question of taking the value of the land into account at all as a means of return to be obtained from the consumer."

To build up an organization to take care of the conditions arising from the bill would paralyze any industry because of the burden of expense. If a property is to be taken over, "fair value" should be paid and the court should fix the compensation. Rights-of-way, water rights, lands and interests therein would increase in value. When hydroelectric energy was first introduced it was possible to obtain private rights-of-way over private lands for transmission lines and other privileges at minimum cost because people were anxious to get the energy and to encourage the enterprise. The company is contending before the Railroad Commission that it is entitled to have regarded as the value of the present rights-of-way the value that they possess to-day. Transmission lines are run along public roads in California in only a very few instances. The new transmission lines are all on private rights-of-way.

Mr. Britton said he did not understand the reason for the provision that no sale of energy shall be made to a distributing company without permission of the Secretary of the Interior. The company sells energy for lighting, heating and motor-service purposes to a number of distributing companies that it does not own or control in California. In a commission-regulated state there could not be any abuse because of the existence of separate corporations for generation and distribution. In California the commission would force a company to supply energy to a distributing company if it thought best to do so.

National Contractors to Meet in San Francisco

Announcement has been made that the National Electrical Contractors' Association will hold its next annual convention in San Francisco on July 18 to 24 inclusive. The convention headquarters will be in the Clift Hotel, and the meetings will be held in the Auditorium of the Civic Center. Contractors from the East will go in a special train, and the first two days in San Francisco will be devoted to sightseeing. A meeting of the directors and executive committee is scheduled for July 20. The program for the rest of the week is as follows:

Wednesday, July 21.—10 a. m., open session: address of welcome, president of the San Francisco association; address by Mr. John R. Galloway, president of the National Electrical Contractors' Association; address by Mayor James Rolph, Jr., of San Francisco; illustrated address by Mr. John Britton, manager Pacific Gas & Electric Company; address by Mr. Charles C. Moore, director-general of the Panama-Pacific International Exposition; address by Mr. W. S. Goodwin, sales manager Pacific States Electric Company. 2:30 p. m., business session. Evening, reception and dance at Clift Hotel.

Thursday, July 22.—10 a. m., business session at Auditorium, Market, Hayes and Larkin Streets. 2 p. m., automobile ride for ladies and guests through Golden Gate Park and Presidio. 2:30 p. m., business session, Auditorium. Evening, N. E. C. A. night at the "Zone," Exposition Grounds.

Friday, July 23.—10 a. m., final business session at Auditorium. 2:30 p. m., board of directors at Clift Hotel. 3:30 p. m., executive committee at Clift Hotel. 7 p. m., dinner-dance and vaudeville at Pompeian Court, Hale Building, Fifth and Market Streets.

Saturday, July 24.—Trip by special steamer around San Francisco Bay and through the Golden Gate, landing at Exposition Grounds early in the afternoon. Luncheon to be served on board.

PUBLIC SERVICE COMMISSION NEWS

Colorado Commission

The Public Utilities Commission of Colorado, in reply to a request from the Trinidad Electric Transmission Railway & Gas Company, has made an administrative ruling that in its opinion all services must be paid for in money and no free service can lawfully be rendered. The street-lighting contract which the company has with the city of Trinidad calls for free lights at various points.

In another ruling the commission holds that it is unlawful for public utilities to exchange free transportation or free service for advertising space in newspapers, for the reason that it is plainly contrary to the act, which is emphasized by the fact that an attempt was made in the Legislature to permit this practice. The attempt, however, failed.

The commission also rules that the provisions of the act are uniformly applicable in all parts of the State and that any charter provisions in conflict with it or with any orders issued by the commission are of no force and effect.

Illinois Commission

The commission has decided that the price the Central Illinois Public Service Company is now charging for gas in Charleston, Ill., is not exorbitant. A lower rate has been ordered, however, because the company agrees that it may be able to sell more gas and thus make up for the deficiency. The rate is reduced from $1.50 to $1.35 gross, or $1.25 net. The commission says:

"It is a matter of very serious doubt whether or not a gas utility in Charleston, under the present conditions of population, can ever pay a substantial return on the capital invested therein, because any reasonable rate of service, even a high one that some few residents might conclude to pay rather than be debarred from using gas could hardly be supposed to be sufficient to cover fully the indirect charges of operation (inseparable from all small plants), operating and depreciation charges, and to pay a reasonable rate of return to the stockholders."

Idaho Commission

Taking the load-factor into consideration, the Public Utilities Commission fails to find any discrimination between the rates charged the Marsh Mining Company and other companies furnished with energy by the Washington Water Power Company.

Explaining that apparent discriminations of this and other kinds may be shown not to be so by an equalization of conditions causing them, the commission decided that there is no reason to believe that the Marsh Mining Company has suffered through rates favoring other companies. This decision, however, the commission says, has no bearing on the reasonableness or unreasonableness of rates charged by the Washington Water Power Company, except as they may be discriminatory in this instance. There is pending before the commission an investigation into these rates, and certain rates which the commission deems fair and equitable to consumers and company alike have been put into effect and are to be maintained until the conclusion of the investigation.

New York Commissions

The Public Service Commission has approved the franchise of the Mechanicsville Electric Light & Gas Company to operate in Schaghticoke, Rensselaer County, and permits the exercise thereof under a contract with the town for lighting Hemstreet Park and the eastern portion of the bridge from Mechanicsville, despite the objections of the Half Moon Light, Heat & Power Company, which was already furnishing energy to private consumers in the town.

The Half Moon company objected on the grounds that it should be protected from competition, under the terms of the public service commissions law, but in an opinion by Commissioner Emmet the commission finds that the intent of this part of the law was toward actual and dangerous competition and not the theoretical or harmless competition found in the present case.

Commissioner Emmet finds that the Half Moon company is the larger, stronger and more profitable concern, and that on the contract for street lighting its bid was $12 per lamp as against the $9.90 bid and accepted by the Mechanicsville company. The Half Moon company covers a far larger territory than the Mechanicsville company, and Mr. Emmet finds that it would hardly be conceivable that this business could be seriously injured by the entrance into so small a portion of its field as the exercise of a single street-lighting contract would involve.

Ohio Commission

The commission has rendered a decision on the joint application of the Sidney Electric Company and the Western Ohio Railroad Company for the transfer of the lighting plant of the latter-named company in Sidney to the Sidney Electric Company. It appears to the commission that the amount agreed upon by the parties for the property is greatly in excess of the actual value and that the purchasing company intends to capitalize the property at its purchase price. It also appears to the commission that the transfer is contingent upon the execution of a contract between the companies fixing the rates which the Sidney Electric Company would be bound to pay to the Western Ohio Railroad Company for electrical energy.

The request of the Mahoning Light & Power Company of Youngstown for permission to purchase the Youngstown Heating Company's plant for $125,000 has been granted. The company received authority to sell at 90 $530,000 of 6 per cent bonds, to mature in twenty years, and $400,000 of capital stock at par, all the proceeds to be invested in the plant and its improvement and development. The Youngstown Heating Company has a franchise to operate in Youngstown, and the new company will have the right to proceed with the construction of a plant. Opposition was made to the grant by the local company on the ground that the territory is now receiving adequate service and that there is no necessity for another company.

It is reported that the Youngstown & Sharon Railway & Light Company will appeal to the Supreme Court from the decision of the commission in the Mahoning County Light Company case. The new company, it is said, will confine its service to the business district of Youngstown, and the old company will appeal on the ground that it is unfair that the best of the business should be sought and the original company be forced to take the outlying business, which will not be so profitable.

The Mahoning County Light Company will begin at once the construction of a plant for furnishing energy for lighting and motor service and also steam heat.

The hearing of the case of the Cleveland Electric Illuminating Company on rates has been continued from Dec. 15 to Jan. 25, pending completion of the valuation.

West Virginia Commission

Applications of four hydroelectric companies which proposed to develop water-powers have been refused by the commission.

Current News Notes

Sleet Storm Brings Down Steel Towers.—The Lehigh Navigation Electric Company has a large force of men employed in erecting wooden poles between Hauto and the Harwood Electric Company's station at Freeland, Pa., to take the place of the steel towers crushed during the recent wind and sleet storms. These poles will be replaced by greatly strengthened steel towers next summer.

* * *

Commission's Consent Not Necessary for Municipal Plant.—The Pennsylvania Public Service Commission recently ruled that the borough of Gettysburg could build and operate its own electric plant to furnish electricity for its streets without obtaining the consent of the commission. The Gettysburg Light Company had filed a protest against the approval of the project of the commission, but the commission ruled that the making of electricity by the borough for street lighting is a governmental function.

* * *

Needle Ice Causes Shut-Down at Hamilton, Ont.—Needle ice at the Decew Falls generating station of the Dominion Power & Transmission Company choked the big flumes during the night of Dec. 14, necessitating the shutting down of the station. Street-railway service and traffic on several suburban roads leading out of Hamilton were at a standstill until 11 o'clock on the morning of Dec. 15, and a number of factories were obliged to close down temporarily. Ice formed in the canal on Dec. 15, so no trouble is expected during the winter.

* * *

Municipal Plant Need Not Necessarily Be a Profitable Venture.—According to a decision of the Franklin County Common Pleas Court at Columbus, Ohio, a municipality may operate electric and other plants at a loss if it sees fit to do so, making up the resulting deficit from taxes. The case arose on an injunction brought by a taxpayer against the Mayor of Columbus attempting to restrain him from charging a rate for electricity from the city's plant which was alleged to be inadequate to meet the cost of operation. The court held that no ground for injunction was stated. The case will be carried to the Supreme Court and is being watched with considerable interest, especially by companies operating electric plants, which have frequently contended that municipal plants do not charge enough to pay the actual expenses of operation.

* * *

Reduction in Ontario Hydro Rates.—Announcement has been made by the Hon. Adam Beck, of the Hydro-Electric Power Commission of Ontario, that, beginning with Jan. 1, 1915, reductions in Hydro-electric rates averaging from 12 to 15 per cent will become effective in all the municipalities using Hydro service, with the exception of the city of Toronto. Port Arthur leads the list with a reduction of 25 per cent, and fifty-five municipalities get reductions of over 10 and under 20 per cent, while fourteen get a 10 per cent reduction. In order to encourage greater use of electricity in the homes of the people for toasters, stoves, irons, vacuum cleaners and such appliances, the commission, after extensive inquiry, has established the normal use of electricity for house lighting. This has been fixed at 40 kw-hr. for a house of 1000 sq. ft. floor area, and for all energy used up to this limit the ordinary rate is charged, but for all in excess of 40 kw-hr. on this class of residence one-half of the initial rate is to be charged. For every hundred feet of floor area over and above 1000, which is fixed as the standard, the estimate for lighting is advanced 3 kw-hr. Thus a house with 2000 sq. ft. floor space would be entitled to the half rate on all energy used over 70 kw-hr. The chief general reduction has been made in the floor space charge, which is to be reduced from 4 to 3 cents per 100 sq. ft. with a minimum service or area charge based upon 1000 sq. ft. and a maximum of 3000 sq. ft. This is the city rate. In villages and rural municipalities the minimum is 1200 sq. ft. of floor space, and in urban districts outside the municipalities the minimum monthly charge is for 1500 sq. ft. The maximum is the same all through. Hitherto there was no maximum, and the service charge increased indefinitely. The rates for energy used by motors with a few exceptions remain the same as those which now obtain.

* * *

SOCIETY MEETINGS

Wisconsin Electrical Association.—The date of the Wisconsin Electrical Association annual meeting has been set for Jan. 20 to 22, the place being the Hotel Pfister, Milwaukee, Wis. Mr. George Allison, First National Bank Building, Milwaukee, is the secretary of the association.

* * *

Minnesota Electrical Association.—At a recent meeting of the executive committee of the Minnesota Electrical Association it was decided to hold the 1915 meeting of the association at St. Paul, Minn., March 23 to 25. Mr. R. E. Brown is president of the Minnesota association, and the members of the executive committee are Messrs. P. T. Glidden, R. F. Pack and E. F. Strong. The secretary of the association is Mr. Fred A. Otto, 159 East Sixth Street, St. Paul.

* * *

Chicago Electric Club.—At the meeting of the Chicago Electric Club on Dec. 17 Mr. John J. Arnold, vice-president of the First National Bank of Chicago, discussed "Currency Legislation—Old and New." Mr. S. B. Joseph, a banker of Buenos Aires, Argentina, advised the extension of American investments in South America if the American manufacturer is to hold permanently the commercial advantage he will gain during the period of the European war and the subsequent reconstruction while European capital is occupied elsewhere. Mr. William H. Lough, representing the United States Bureau of Foreign and Domestic Commerce, Washington, D. C., urged American business men to utilize the present opportunity for foreign trade extensions. Mr. C. P. Connelly, a former secretary of the club also spoke.

* * *

Second National Foreign Trade Council.—"Greater prosperity through greater foreign trade" is the objective of the second National Foreign Trade Convention to be held at St. Louis on Jan. 21 and 22, 1915. Three thousand commercial and industrial organizations, corporations, firms and individuals engaged in foreign trade have been invited to send delegates. In a letter to them Mr. James A. Farrell, president of the United States Steel Corporation and chairman of the National Foreign Trade Council, says: "Co-ordinated effort of the entire nation—manufacturers, merchants, bankers, carriers and all others—working together in harmony with a well-defined national policy, will alone enable us to develop the possibilities now before us." To present the effect of the war on United States trade, Mr. John Bassett Moore, formerly counselor of the State Department, will speak on "Problems Arising in War and Commerce." Secretary of Commerce Redfield will open the convention.

PANAMA-PACIFIC INTERNATIONAL EXPOSITION FROM RUSSIAN HILL, SAN FRANCISCO

Electrical Equipment of Panama-Pacific Exposition

Various features of the exterior and interior electric distribution system—Extensive use of wooden manholes and conduit—Decorative and general illumination

THE main exhibit section of the Panama-Pacific International Exposition, which will be thrown open to the world in San Francisco on Feb. 20, is now complete, and the great group of white palaces facing San Francisco harbor is rapidly being filled with exhibits arriving in trainloads daily. From the "Zone" flanking one side of the exhibit section to the pavilions of the states and foreign nations on the other side, the grounds extend along the waterfront for almost 3 miles. Many of the spectacles to be shown upon the Zone have long since been completed and open to the public, and little remains to be done by the army of workmen to put the finishing touches on the entire exposition, which will be ready long in advance of the day set for its formal opening.

The electrical equipment of the exposition grounds is unlike that of any other exposition thus far held; for by means of a very generous contract with the Pacific Gas & Electric Company the exposition company is enabled to obtain excellent construction at minimum expense. Wherever possible standard equipment of the Pacific Gas & Electric Company is employed and the lead-covered cable, switches, transformers, etc., will be returned to the electric company after the exposition is over at their face value, the exposition company paying a rental, as it were, on the reclaimable equipment. In all other cases the construction is designed to last for the life of the exposition, and consideration has been given in the layout to the fact that much of the wiring material will possess a scrap value.

Electric Supply

Electricity for the exposition is supplied by the Pacific Gas & Electric Company from a substation erected by it in one end of the steam station belonging to the Sierra & San Francisco Power Company and situated outside the exposition grounds. The energy will be generated at the Pacific Gas & Electric Company's main steam plant in South San Francisco, and in case of an interruption of service the Sierra & San Francisco Power Company's steam station will take the exposition load.

The exposition company's feeders consist of three-conductor, three-phase, lead-covered cables, of 000, 00 and No. 2 capacity, with weatherproof neutrals forming three-phase, four-wire, 4000-volt feeders running in underground conduit from the Pacific Gas & Electric Company's substation to various parts of the grounds.

Transformer Vaults

The main group of exhibit buildings are fed from fireproof concrete transformer stations installed in the corners of the buildings, with doors opening to the outside and with ventilating ducts built through to the roof. These vaults were all built with the approval of

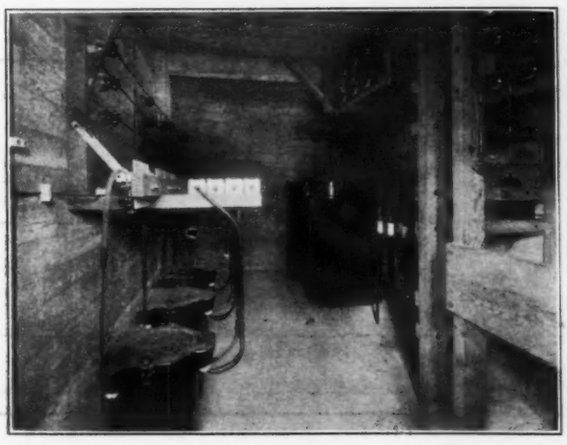


FIG. 1—TRANSFORMER VAULT, MANUFACTURES BUILDING

FIG. 2—TRANSFORMER VAULT IN AGRICULTURAL BUILDING

FIG. 3—TRANSFORMER VAULT IN LIBERAL ARTS BUILDING

the Pacific Board of Fire Underwriters and are fitted with a fireproof door held open by a fusible link and with an outer metallic screen door for ventilating purposes. Interior views of these vaults showing the transformer vaults. Similar transformer vaults are also provided in the states and foreign sites, feeding the pavilions of the various state and foreign nations.

Overhead Distribution

The Concessions District, at the extreme east end of the grounds, is fed by means of four four-wire, three-phase, 4000-volt overhead feeders running along the service roads back of the Concessions streets. These feeders are controlled from the same substation as the underground circuits; two of them will supply energy for motors and two will supply energy for lighting in the Concessions District. The extreme westerly part of the grounds, including the race track, drill grounds and stock yards, will be fed from an aerial extension of one of the underground cable feeders.

Underground Distribution

The exposition's underground system consists of 1/8-in. "linaduct" conduit laid in sections of wooden boxing approximately 18 ft. in length, having 1 in. of sand between the bottom of the box and the first layer of conduit and 3/4 in. of sand between each conduit in a layer. This sand is sluiced into place with water and a wood cover nailed over the box after the conduit is in place.

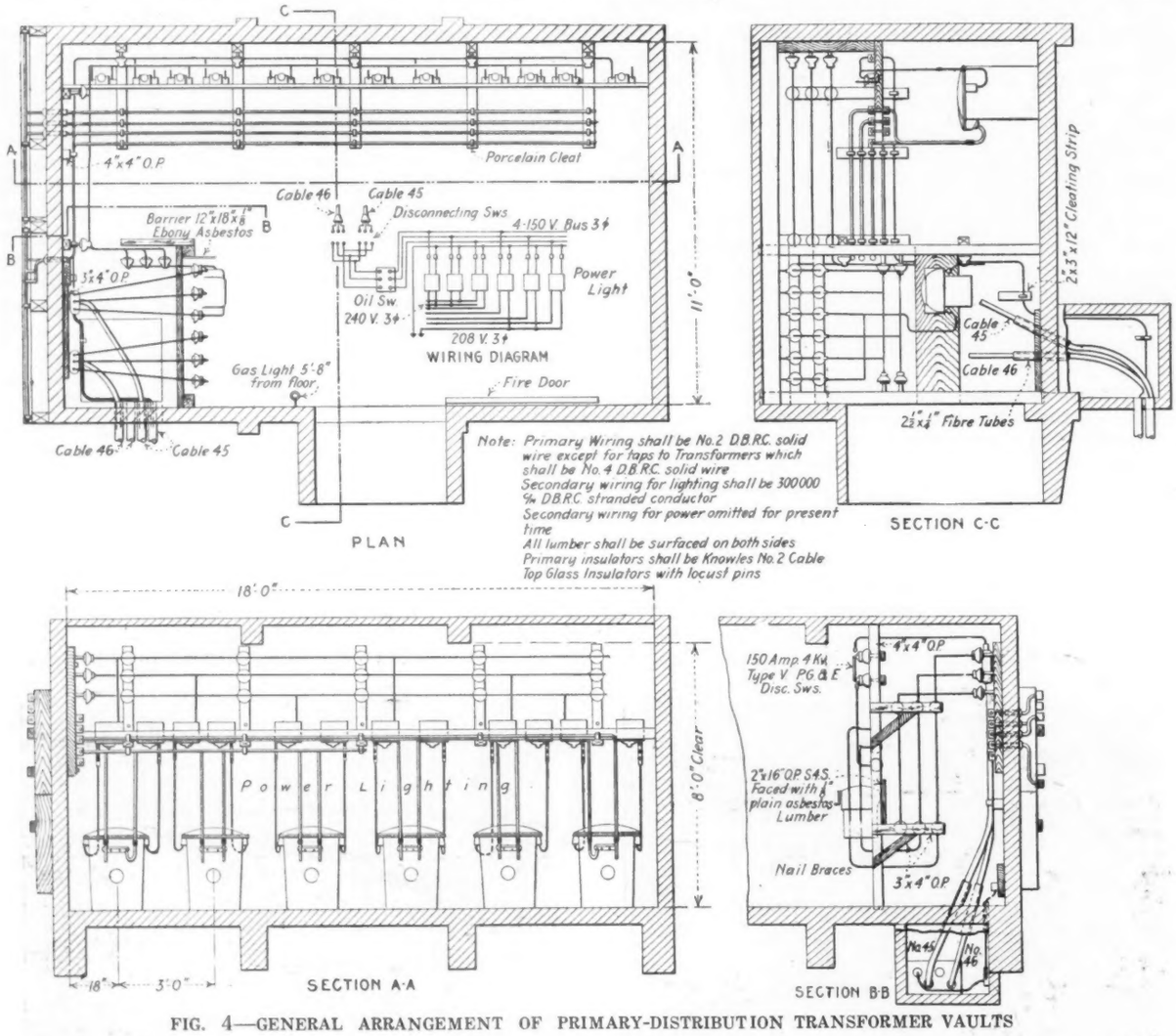


FIG. 4—GENERAL ARRANGEMENT OF PRIMARY-DISTRIBUTION TRANSFORMER VAULTS

equipment are given in Figs. 1, 2 and 3, showing vaults in the Manufactures, Agriculture and Liberal Arts buildings respectively. In addition Figs. 4 and 5 show details of wiring layout and arrangement in these

The manholes themselves are of Oregon pine, a detail of them being shown in Fig. 6. It will be noted that the manholes have a protruding entrance box with counterbored holes against which the conduit abuts, and

about 3 ft. of concrete is placed in the box nearest the manhole, this to form a rigid entrance for the conduits into the manhole and to form an anchorage against pulling. The protruding entrance, while very low in cost, gives the effect of a much longer manhole in allowing the bend of the cable to start before it actually

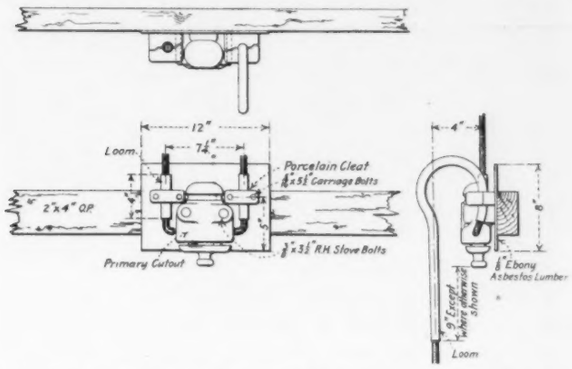


FIG. 5—METHOD OF MOUNTING PRIMARY CUT-OUTS AND LEADS

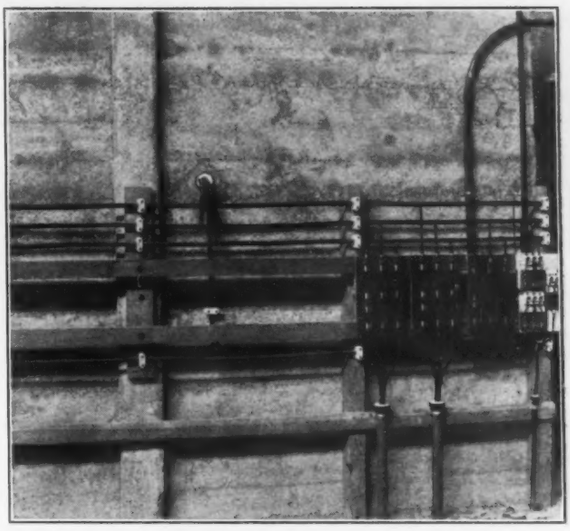


FIG. 7—TYPICAL DISTRIBUTION RACK ON EXTERIOR WALL OF TRANSFORMER VAULT

enters the manhole proper. The detail of another type of manholes used is shown in Fig. 8.

The details of the wooden-box construction are shown in Figs. 9 and 10. A portion of the conduit system using concrete construction is employed on the trunk line from the Avenue of Progress to the station and approximates about 1200 ft.

The type of wooden-box construction has proved not only low in cost but especially efficient under the prevailing conditions in withstanding strains due to undermining by the enormous number of earth cuts underneath and around it for sewer, water, gas and minor electric services. In some cases the conduit has supported a span of as much as 10 ft. without damage, and in numerous cases the whole weight of plaster scaffolding has rested on the box without detriment to the conduit.

The low-voltage distribution for lighting consists of transformation from 4000-volt star-connected mains to four-wire, three-phase, 115-volt lighting mains for

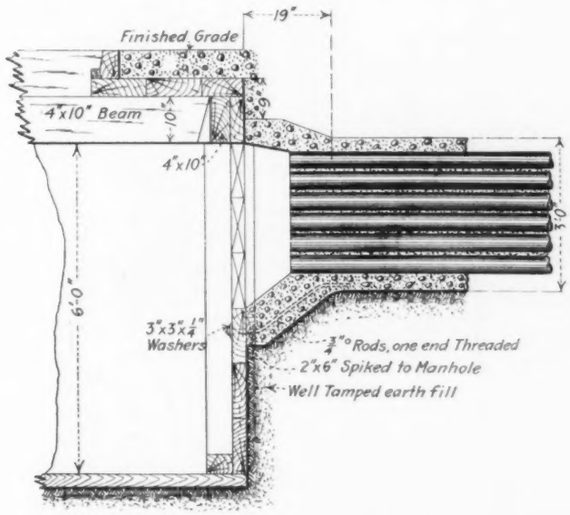


FIG. 6—SECTIONAL ELEVATION OF MANHOLE

general distribution. The lighting mains, in proportion to their size, are served from either one, two or three phases, and in many cases small three-phase motors are also fed from the outside of the four-wire three-phase system which furnishes 208 volts, proving ample to run motors of small capacity.

The distribution for motors consists of transformation from 4000-volt star-connected mains to three-wire, 220-volt delta-connected circuits. Fig. 7, giving a view of the outside of one of the transformer vaults in the main group of buildings, shows the typical distribution rack from which the feeders proceed underneath the floors of the main exhibit palaces and there serve the exhibitors' booths. According to another scheme, in one of the Machinery Building vaults, owing to the heavy currents, the distributing busbars consist of flat copper strips.

Underground Cable System

Fig. 17 shows the general scheme of the underground cable system and switching arrangement in the transformer vaults. Owing to a very liberal contract made

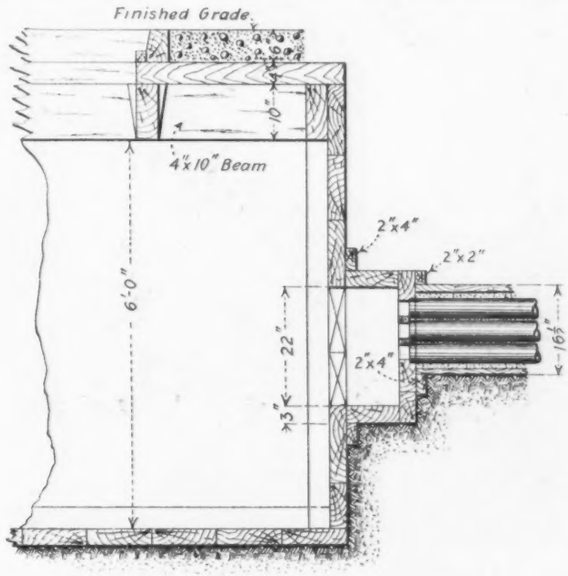
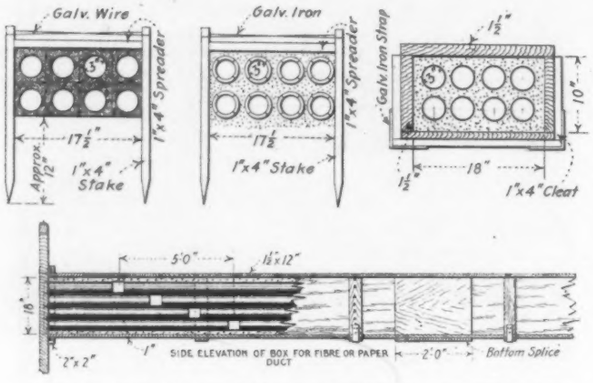


FIG. 8—DETAIL OF WOODEN MANHOLE

with the Pacific Gas & Electric Company the exposition company has been enabled to install a cable system of extreme flexibility—such that in case of losing half of the main cables the system would still be able, with very

little loss of time, to handle practically all of the load.

In order to furnish the necessary direct current for the approximate 2000 kw in searchlamps which will be around the grounds it was found necessary to install two 1000-kw motor-generator sets and two 250-kw bal-



FIGS. 9 AND 10—DETAILS OF CONDUIT CONSTRUCTION

ancer sets, these machines being installed in the Liberal Arts and Manufactures buildings and the Scintillator House. The 1000-kw machines are driven by 11,000-volt synchronous motors, and the 250-kw balancer sets are driven by two-phase, 2300-volt motors, a T-connection from 11,000 volts to 2300 volts being made to supply them with energy.

In the general illumination plan for the main group of buildings and courts, no direct illumination is used, and none is allowed on other buildings owned by con-

FIG. 11—TRAVELING CRANE ERECTING THREE-LAMP MAGNETITE-ARC FIXTURE

cessionaires or exhibitors that are situated within this district. Outline lighting is allowed in the states and foregn sites and Concessions streets when submitted for approval to the exposition company.

Outside Illumination

The plans for street and general illumination consist of the following:

A number of series magnetite-arc circuits are installed, with the lamps set on ornamental poles grouped

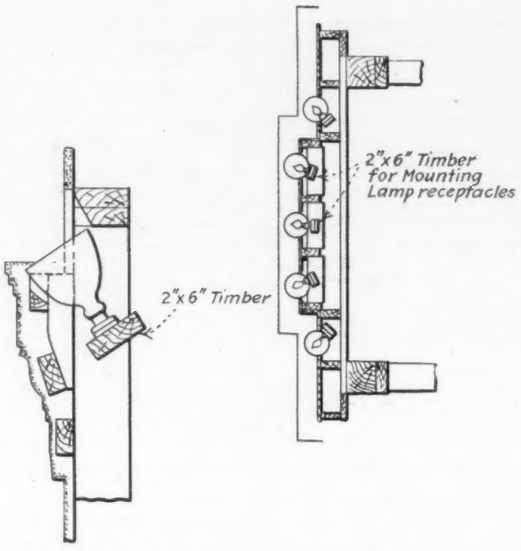


FIG. 12—DETAILS OF COVE LIGHTING IN COURT OF FOUR SEASONS

along the roads facing the main exhibit palaces. These lamps are placed in one-lamp, two-lamp, three-lamp, five-lamp and nine-lamp fixtures, being mounted on turned

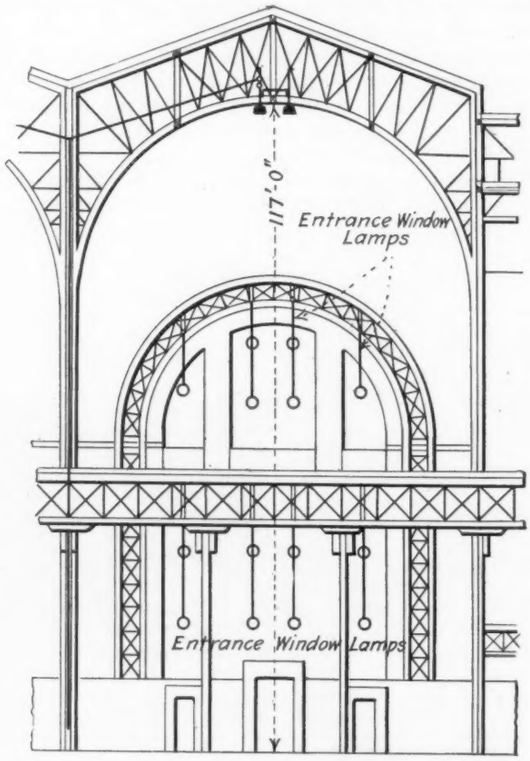


FIG. 13—DECORATIVE WINDOW LIGHTING IN MACHINERY PALACE

wooden poles with ornamental staff bases and ornamental staff deflecting shields, or decorated banners which act as deflectors. The plan of the illumination is to have the light thrown against the travertine-colored

walls of the buildings, which in turn will furnish a secondary field of illumination for the area behind the lamps.

The ornamental heraldry banners are, to a small extent, translucent, and the ornamental staff deflectors have panels of translucent fabric which allows a mild glow to be seen from the back of the fixtures.

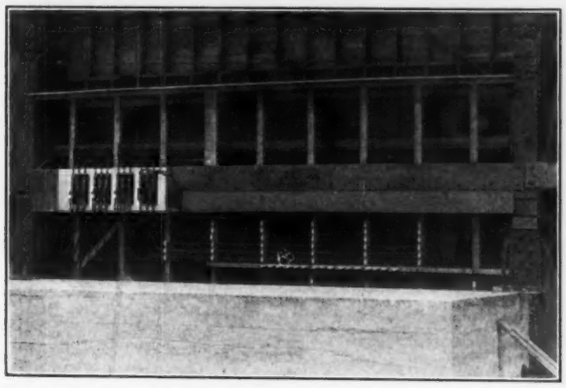


FIG. 14—DISTRIBUTION CIRCUITS FROM TRANSFORMER VAULTS IN MACHINERY BUILDING

The street lighting in the court ways, South Gardens, and along portions of the water front consists of ornamental staff standards, on which are mounted high-efficiency tungsten lamps, varying in rating from 400 watts to 1500 watts.

The general illumination in the states and foreign sites is secured by means of 250 high-pressure gas arcs.

Spectacular Illumination

The special outside lighting features consist of two ornamental fountains in the Court of Honor, the top of which consists of fluted columns of glass, approximately 5 ft. in diameter and made luminous by means of 200-kw of 1500-watt tungsten lamps. There is an intermediate diffusing plate between the lamps and the fluted glass of the column proper.

FIG. 16—WINCH USED FOR THE PURPOSE OF PULLING CABLES IN CONDUIT

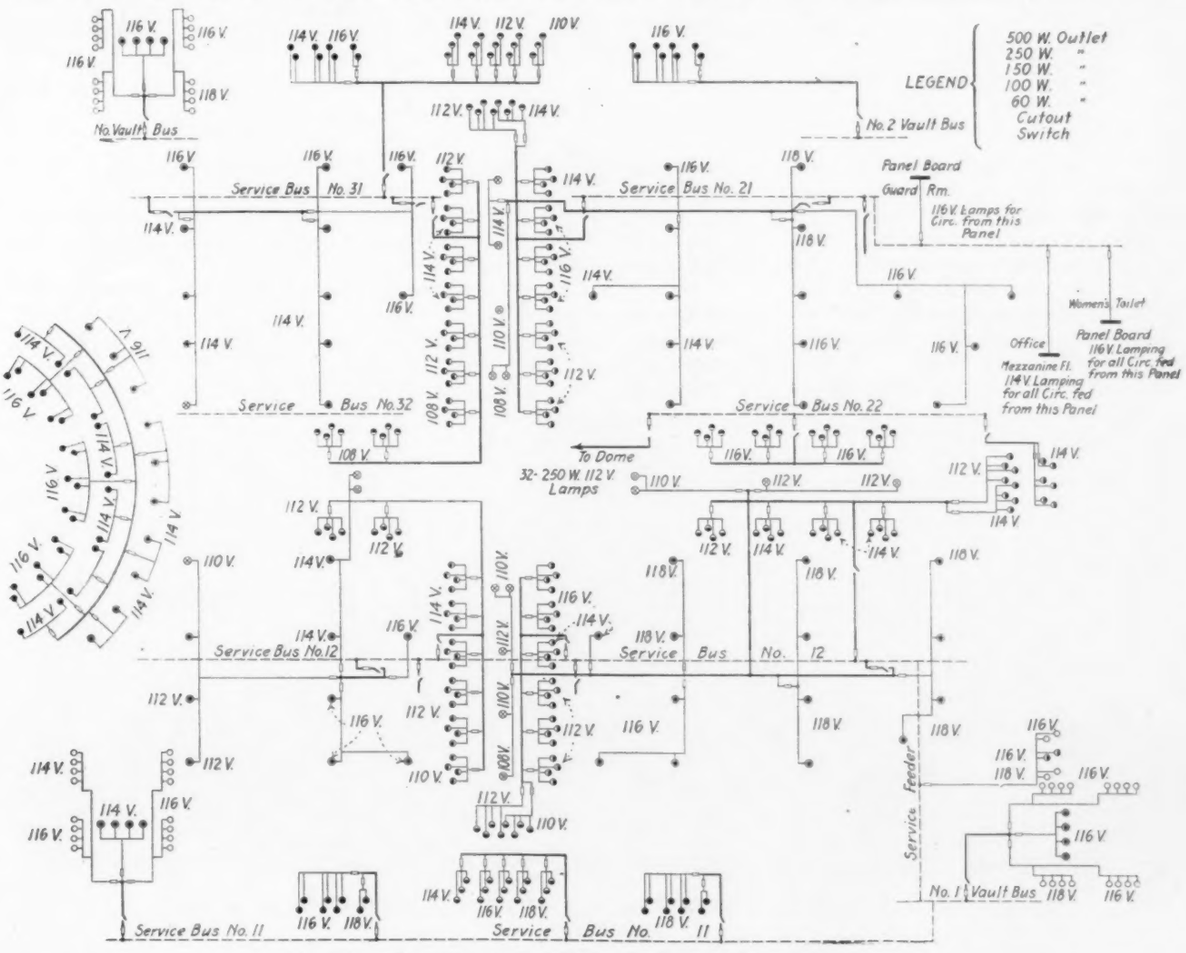


FIG. 15—WIRING DIAGRAM OF EDUCATION BUILDING

Another feature is the glass dome of the Horticulture

Building, 150 ft. in diameter, a view of which is shown in Fig. 18. This dome will be rendered luminous by means of twelve 30-in. projectors situated on the ground floor directly beneath the dome, the lamps being arranged in a circle and tilted at an angle of approximately 45 deg., where their rays pass through revolving color screens and a revolving series of diffusing lenses, producing a uniform lighting field over the whole dome. By means of special differential drives on the color screens and on the lenses various effects and patterns can be produced on the glass dome.

Another notable outside illuminating feature will be the scintillator, situated on the point of land outside of Fulton Basin Harbor. Forty-eight 36-in. projectors will be mounted on this scintillator pier, and by means of color screens and diffusion doors a great variety of sky illuminating effects will be obtainable.

As a part of the general scheme of outside illumination in addition to the scintillator, approximately 320 searchlamps, varying in size from 13 in. to 30 in., will be used for flood-lighting various parts of the main group of buildings, statuary groups and towers. These projectors will be mounted on top of the main entrance gates, along the hedges, and at various points on the roofs and parapet walls of the main group of buildings and tower.

In addition to these direct-current searchlamps, there will be used 200 6-volt incandescent, concentrated-filament spot lamps for the flood-lighting of special statuary, and 250 500-watt, 120-volt concentrated-filament flood lamps for flag illumination around the main group of buildings and courts.

Further to complete the night picture from the outside of the buildings, a large number of tungsten units will be suspended with diffusing reflectors back of all clerestory windows and main entrance doors, the glass in all of these entrances being especially colored and treated to give the effect of a brilliantly lighted building. These lamps will be turned on after the palaces have been closed and will continue to be used during the period of general illumination. After this period is over, a group of large wattage units suspended over the aisles, with special reflectors, will be turned on for the use of janitors. These reflectors have been very eco-

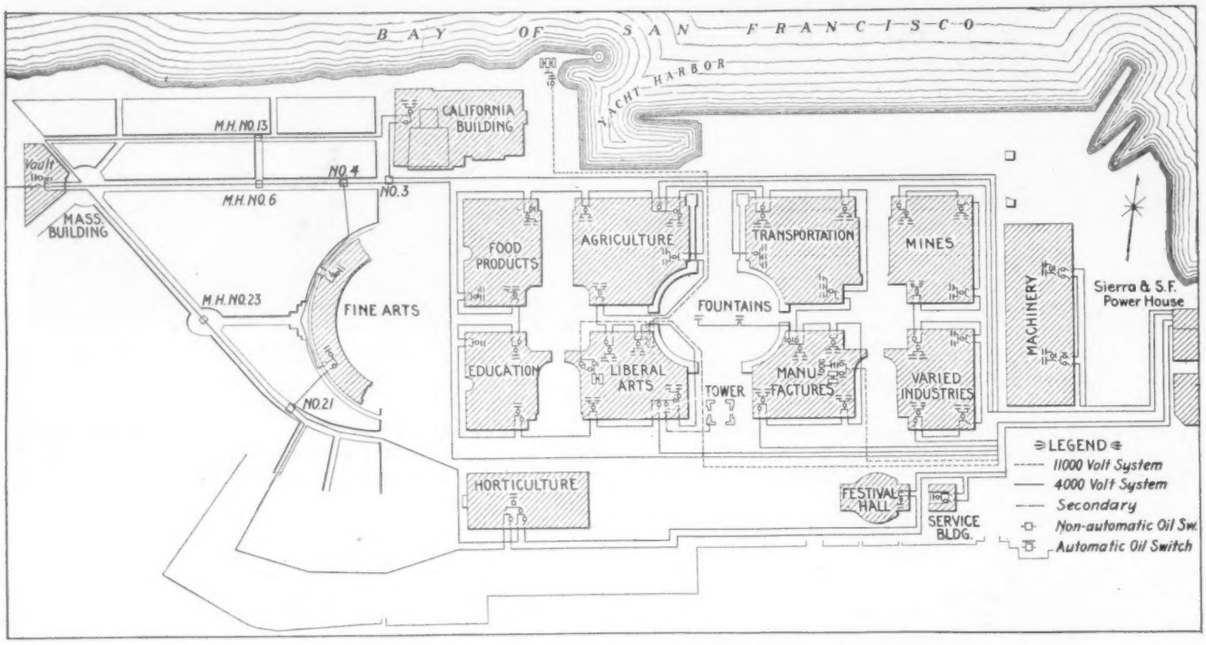


FIG. 17—GENERAL SYSTEM OF DISTRIBUTION IN EXHIBITION SECTION OF PANAMA EXPOSITION

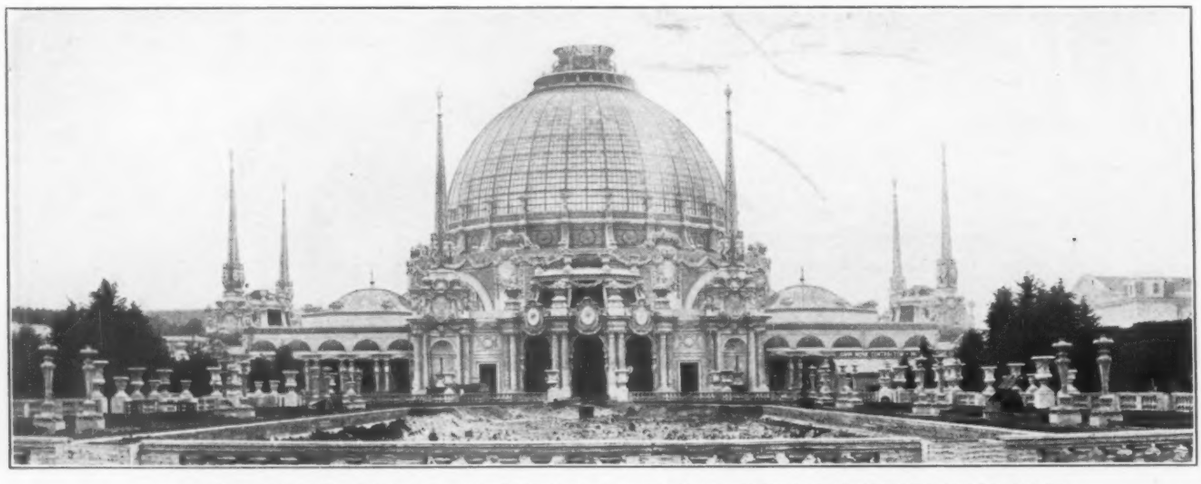


FIG. 18—GENERAL VIEW OF HORTICULTURE BUILDING WITH ITS IMMENSE GLASS DOME

nomically designed, and while the power used amounts to only 0.2 watt per sq. ft. of floor area, a very acceptable amount of illumination is obtained.

The details of the decorative window lighting in the Machinery Building are shown in Fig. 13.

Fig. 11 shows the steam traveling crane used in erecting the arc-lamp fixtures. The illustration shows a

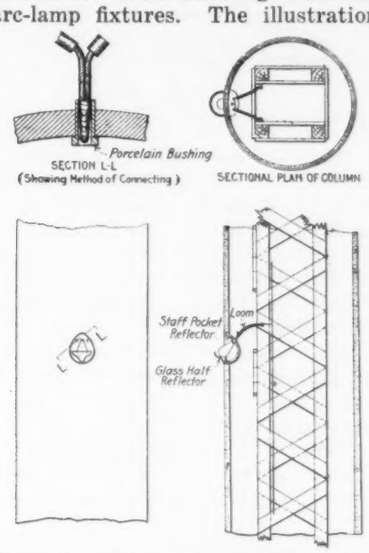


FIG. 19—COLUMN OUTLET AND REFLECTOR FOR COLONNADE

three-lamp magnetite-arc fixture being hoisted in place. The openings shown in the staff ornament at the top are blanked off with translucent fabric as mentioned elsewhere. The poles have a curved slot for concealing the wires and are painted to conform with the general color scheme and have an ornamental staff base installed at the ground line. For hauling the transformers to the various transformer stations on the ground a storage-battery truck with special rigging, as shown in Fig.

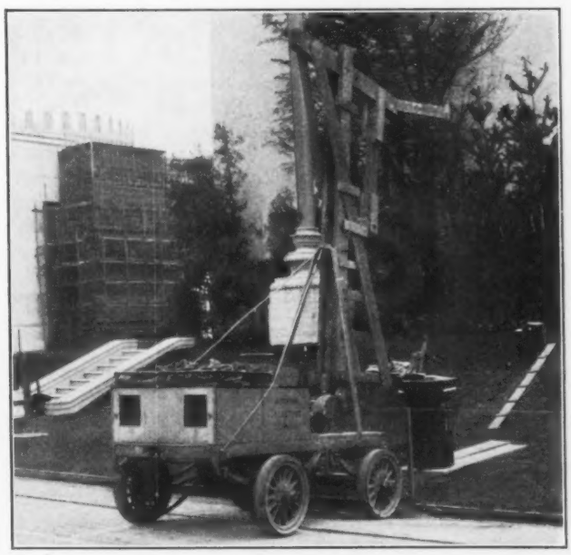


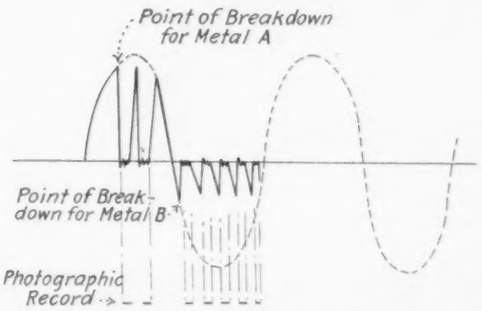
FIG. 20—BATTERY TRUCK EQUIPPED FOR CARRYING TRANSFORMERS

20, was used. The gasoline-engine-driven winch employed for drawing the cable in the underground conduit (Fig. 16) has proved serviceable and economical.

The entire electrical installation of the exposition was planned by Mr. G. L. Bailey, chief electrical and mechanical engineer, assisted by Mr. L. F. Leurey. The lighting features were in charge of Mr. W. D. Ryan.

Spark Discharges Between Unlike Metals

Contrary to former impressions, the experimental results obtained by Prof. Daniel M. Rich, University of Michigan, seem to indicate that electric sparks take place from positive electrodes of certain metals more readily than from those of other metals. Applying an alternating-current potential to a spark-gap between a copper electrode and a zinc electrode, and rapidly photographing the spark discharges, the experimenter found that while discharges from the copper electrode during one-half cycle were quite limited, many sparks were given off from the zinc during the following one-half cycle of reverse direction. To account for this phenomenon, Professor Rich recently explained, before the American Physical Society, his belief that the potential must be built up to a higher value before it will jump from the copper as the positive electrode than is the case from the zinc as positive. It was also observed that an even number of sparks always occurred from one electrode while an odd number took place from the other. Oddly enough, these number sequences did not follow the law which they might be expected to obey, for, instead of the last spark oscillation occurring from the electrode



SPARKS BETWEEN ELECTRODES OF DIFFERENT METALS

which had the lowest break-down value, the reverse was true. Professor Rich thinks that the ionizing effect of the arc may perhaps rightly be held accountable for this unexpected occurrence.

Electrolytic Oxygen Manufactured in St. Louis

Several factories in St. Louis, Mo., are now engaged in the electrolytic production of the commercial oxygen gas which has recently come to be an important agent in welding and cutting metals. The electrolyte used is a 10 per cent or 15 per cent solution of either caustic soda or caustic potash. As direct current traverses the electrolyte the oxygen given off at one electrode is collected and compressed, while the hydrogen given off at the other electrode is allowed to escape.

One well-equipped oxygen factory in St. Louis receives energy through three 75-kva transformers from twenty-five-cycle, 13,000-volt primary lines. At a reduced potential this alternating current is used to drive a 100-kw motor-generator set, a 20-hp motor connected to an air compressor and a 10-hp motor for miscellaneous work. Direct current for the electrolytic process is taken from the motor-generator set. With this equipment it is claimed that the oxygen company can produce about 3 cu. ft. of oxygen gas for each kilowatt-hour used. This plant operates continuously twenty-four hours a day. Another process, employing liquid-air, has been tried, and although less electricity is used, the first cost of the apparatus is declared to be higher than that which is required for the electrolytic process.

Photometry of the Gas-Filled Lamp

An analysis of the causes for the variation of current and candle-power with speed of rotation. By G. W. Middlekauff and J. F. Skogland

AN investigation which the authors have had in progress for some time at the Bureau of Standards[1] has shown that all tungsten lamps of the vacuum type, within a wide range of wattage, have the same voltage-current-candle-power characteristics regardless of the make or method of manufacture. When this investigation was extended to include the gas-filled lamp, it was soon found that entirely new and unexpected variables, not present in the vacuum lamp, had to be considered and studied.

On account of irregularity in the arrangement of the filament as mounted in this type, there is a corresponding irregularity in the distribution of the light about the vertical axis. Consequently, in determining the mean horizontal candle-power it is necessary to rotate the lamp at a relatively high speed in order to avoid disagreeable flicker. Fortunately, this difficulty is readily overcome by placing back of the lamp two mirrors[2] inclined to each other so that the photometer screen is illuminated simultaneously by the direct light from the lamp and the reflected light from the mirrors. With this arrangement very low speeds of rotation may be used.

Although this expedient obviates the flicker difficulty, it does not eliminate the most serious trouble caused by rotation. It is found that both current and candle-power have different values when the lamp is rotating and when it is stationary, and that for any change in speed there is a corresponding change in current in one direction and in candle-power in the opposite direction. Furthermore, the direction of these changes depends upon whether the speed is above or below a certain (critical) value. For most values of speed these differences are of sufficient magnitude to affect seriously the results of candle-power and efficiency determinations.

The gas-filled lamp, therefore, presents one of the most perplexing problems of photometry, involving not only increased color difference difficulties over those encountered in photometering vacuum-type lamps but also the difficulty of dealing with variables which may introduce considerable uncertainty in the results.

Some of the results obtained in a study of this lamp are given below with the hope that they may not only aid in determining the cause of the observed variations but may also suggest a satisfactory and practical method of solving the photometric difficulties.

Lamps, Apparatus and Method

The lamps used in the experiments described below were of the nitrogen-filled 450-watt series and 750-watt and 1000-watt multiple types, all having round bulbs with the filaments centrally mounted. The number of anchor wires in each varied from five to nine. Check measurements were made with a number of 200-watt series and 750-watt multiple lamps with straight side bulbs, the former having one anchor wire, the latter five.

Measurements of voltage and current were made simultaneously by means of two potentiometers. The rotator was supplied with mercury-cup connections and two sockets so that the lamp could be mounted either tip up or tip down. The rotating mechanism was under perfect control at every speed which was determined by a specially designed indicator, and the current to the lamp was supplied from a storage battery, thus insuring perfectly steady working conditions. In the candle-power measurements use was made of the two-mirror arrangement described above.

A few preliminary tests indicated that for any change in speed the change in candle-power was, roughly, ten times the change in current but always in the opposite direction. As current can be measured with considerably higher accuracy than candle-power, such measurements furnish a convenient method of determining, approximately, the variation of the candle-power. It

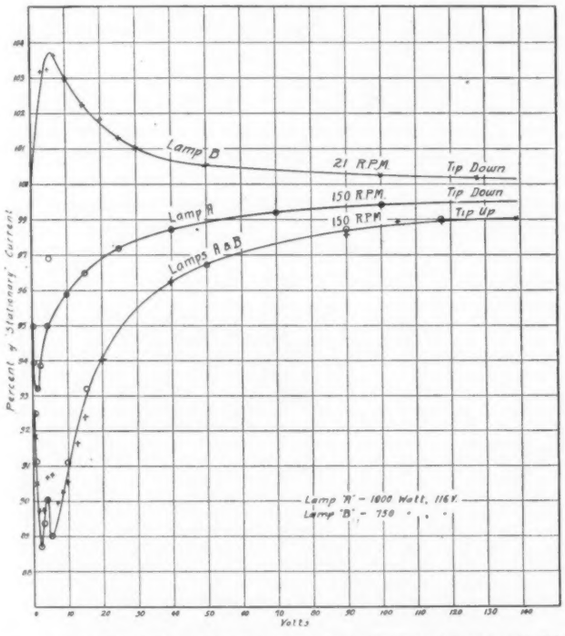


FIG. 1—RATIO OF CURRENT WITH LAMP ROTATING AT CONSTANT SPEED TO CURRENT WITH LAMP STATIONARY

was, therefore, decided that before making careful determinations of candle-power it would be advisable to make a series of measurements of voltage, current and speed, varying only one of these quantities at a time.

Effect of Rotation on Current

In order to determine the effect of change in speed when the voltage on the lamp was held constant, a test was made with a 116-volt, 750-watt short-necked lamp, and three series of measurements were taken, these being with voltage held constant at 90, 105 and 116 respectively. In each series current readings were taken at different predetermined speeds, a reading with the lamp stationary being made as a check between the changes of speed. In this experiment the lamp was used first tip up and then tip down. With the lamp in either position and the speed above 40 r.p.m. the current de-

[1] *Bulletin* of the Bureau of Standards, Vol. 11, page 483. Scientific Paper No. 238.
[2] *Bulletin* of the Bureau of Standards, Vol. 2, page 416.

creased with increasing speed, the effect with tip up being about twice as great as with the tip down. Other lamps of the same size and of different sizes (450 watts to 1000 watts) of different manufacture were tested in the same manner and similar results were obtained in every case.

When the 450-watt, 6.6-amp lamps were tested at constant current it was found that the voltage increased with the speed. This might have been expected, for if the current decreases with increase of speed at constant voltage maintenance of the current observed with the lamp stationary must require an increase in voltage and power consumption as the lamp is rotated.

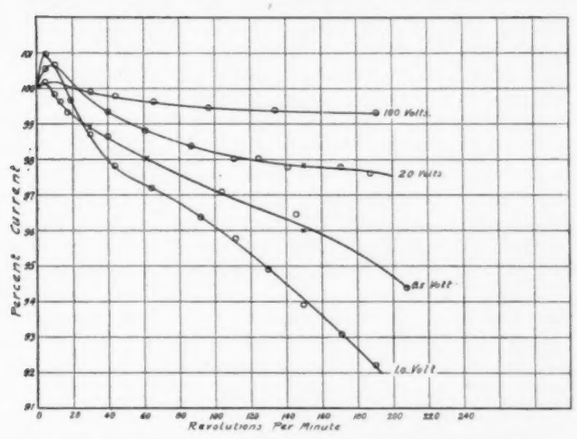


FIG. 2—RATIO OF CURRENT WITH LAMP ROTATING TIP DOWN AT DIFFERENT SPEEDS TO CURRENT WITH LAMP STATIONARY; VOLTAGE CONSTANT AT DIFFERENT VALUES.

Current Variation at Constant Speed with Different Voltages

The next step was to determine the changes in current due to rotation at a specified speed at different values of voltage through a wide range. This test was applied to two lamps, the 750-watt lamp mentioned above and a 1000-watt lamp, both rated at 116 volts. Readings of current corresponding to a chosen voltage were made first with the lamp stationary, then with it rotating at a speed of 150 r.p.m. In this way the changes in current for each lamp at different voltages over a range from 0.5 volt to 100 volts were obtained. The results for both lamps rotated tip up are shown by the lowest curve in Fig. 1, values obtained for the 750-watt lamp being represented by crosses, those for the 1000-watt lamp by circles. The behavior of the current in these two lamps is thus shown to be practically identical at every value of voltage except from 3 volts to 8 volts, which is a critical region. It is probable that even within this region these curves would be found to coincide also were measurements made at a sufficiently large number of neighboring points. The upward indentation in the curve at this point is as real and reproducible as any other part of the curve. Its presence suggests that this curve may be considered as representing the resultant of simultaneous influences which affect the current.

The middle curve of Fig. 1 shows the change in current produced by the same speed with the 1000-watt lamp rotated tip down. This curve is traced through all values obtained except one in the neighborhood of 5 volts. This value indicates that an indentation would probably be found in this curve also were sufficient time taken to pass by small voltage steps through this region. It might be stated that in order to obtain accurate measurements of current values in this region at least ten minutes is required at each point, as small variations of speed resulted in relatively large changes in current. These two curves are similar in form, both becoming asymptotic to the axis of abscissas at about 1 per cent and 0.5 per cent, respectively, below the current observed for the lamp in the stationary position. That is, for this speed, at about 85 per cent of the normal voltage, the current reaches a value which, from that point on, bears a practically constant ratio to the value at zero speed.

Current Variation at Constant Voltage with Different Speeds

In order to investigate further the behavior of the current in the critical region above mentioned, as well as at other points, measurements of current at constant voltage, with variable speed, in succession at different values of voltage were made on the 1000-watt lamp through a considerable range extending as low as 0.5 volt. The speed was varied from 5 r.p.m. to 200 r.p.m., the lamp being rotated tip down. The results of this test are shown in Fig. 2. The important fact indicated by these curves is that when the speed is reduced below a certain value there is a reversal in the direction of the change in current for all values of voltage.

In order to confirm this reversal effect, the 750-watt lamp was tested tip down while rotating at a speed of 21 r.p.m. The results of this test are shown by the uppermost curve of Fig. 1. It will be noted that this curve is of practically the same form as the other two curves of this figure but turned in the opposite direction and lying entirely above the 100 per cent or stationary values.

If values of current corresponding to different chosen values of speed be read from the various curves of Fig. 2 and be plotted, there may be obtained for the 1000-watt lamp a family of constant speed curves similar to those shown in Fig. 1.

Effect of Rotation on Candle-Power

The effect of rotation on candle-power was very strikingly shown by the following experiment: The voltage was so adjusted that the filament when stationary was just visible in a darkened room. Upon rotating the lamp at a speed of about 180 r.p.m. it was found that, although the current decreased in value, the intensity of the light largely increased, the effect being greater with the tip up than with the tip down, thus corroborating the preliminary measurements of current and candle-

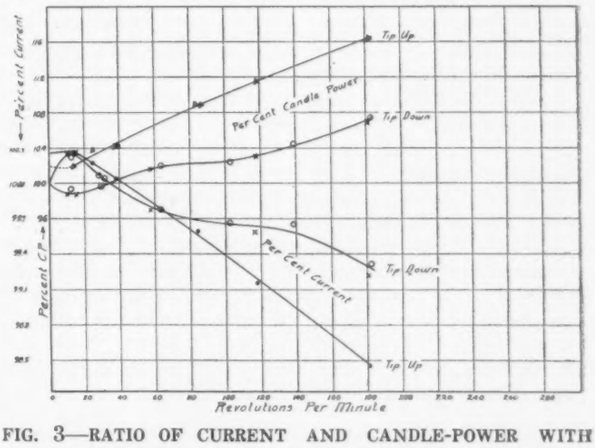


FIG. 3—RATIO OF CURRENT AND CANDLE-POWER WITH LAMP ROTATING TIP UP AND TIP DOWN TO CURRENT AND CANDLE-POWER, RESPECTIVELY, WITH LAMP STATIONARY TIP DOWN

power at higher voltages. With the lamp in either position the upper loops of the filament glowed more brightly than the lower ones, thereby indicating a considerable difference in temperature between neighboring regions of the gas.

As there was found a change in candle-power corresponding to every change in current and since there was a reversal in the direction of the change in current, it was considered probable that a reversal in the direction of the change in candle-power would be found also. This led to a series of simultaneous measurements of current and relative values of the candle-power, with voltage constant and speed varied over a wide range.

Results obtained in this way with the 750-watt lamp when run at 90 volts are shown by the curves of Fig. 3. All values of current and candle-power are expressed in percentages of the values of these two quantities obtained with the lamp stationary and the tip down. In determining the candle-power with the lamp stationary, readings were taken at intervals of 7.5 deg. about the vertical axis, there being a total of forty-eight determinations.

The curves for the lamp with the tip down are the result of two independent series of measurements made on different days, values obtained in the two series being represented by crosses and circles respectively.

Conclusions

The curves of these three figures disclose a number of interesting and important facts, as follows:

(1) With the lamp stationary both the current and the candle-power are greater with the tip up than with the tip down.

(2) For any change in the speed of rotation at constant voltage there is a corresponding change in the current in one direction and in the candle-power in the opposite direction.

(3) The ratio of the change in candle-power to the change in the current is practically constant, being about ten to one regardless of the position of the lamp.

(4) Values of the current and the candle-power are reproducible to a high degree of precision.

(5) Candle-power change with the tip up is about twice the change with the tip down. Similarly the change in current with the tip up is about twice the change with the tip down.

(6) Both the current change and the candle-power change reverse in sign, this occurring at a slightly lower speed with the tip up than with the tip down.

(7) For a given position of the lamp, both the current and the candle-power return to the stationary value at the same speed. For the lamp shown in Fig. 3 this occurs at 14 r.p.m. with the tip up and 34 r.p.m. with the tip down. For the tip-up position this point of intersection is determined by displacing the curves so that they coincide at the point of zero speed.

(8) For the lamp of Fig. 3 rotated at 180 r.p.m. with the tip up the change in candle-power is about 16 per cent, while at 70 r.p.m. with the tip down it is 2 per cent, giving a difference of 14 per cent. This is the descrepancy which is possible when lamps are photometered while rotating under these two different conditions.

A Practical Photometric Method

These results at once suggest a practical method of determining the mean horizontal candle-power without introducing errors due to rotation; that is, to photometer the lamp with the tip down while rotating at the particular speed which gives the same current value as when the lamp is stationary. The advantage of photometering the lamp rotating instead of stationary at a number of points around the vertical axis is that considerably less time and labor are required. The advantages of placing the lamp with the tip down are: (1) the changes caused by variations in speed are less than with the tip up; (2) the current returns to stationary value at a more practical speed than it does with the tip up; (3) at zero speed the lamp thus takes the same current and has the same position as when in service or on life test.

Upon testing all available 450-watt to 1000-watt lamps, including both series and multiple types in round bulbs and one 750-watt lamp in a straight-side bulb, it was found that in every lamp while rotating with the tip down the current returned to the stationary value at a speed between 33 r.p.m. and 40 r.p.m. This held true for a considerable range in voltage, extending above and below normal. The series lamps included in this test have the same form of mount and practically the same arrangement of filament as the multiple lamps.

It is interesting to note that the current of a number of 200-watt, 6.6-amp lamps, with V-shaped filament and a single anchor wire, when submitted to this test did not return to the stationary value in current until a speed of from 140 r.p.m. to 160 r.p.m. was attained, the value of the current being greater than the stationary value up to the speed mentioned. It appears therefore that the smaller the number of loops and corresponding anchor wires in the lamp the greater the speed that is required to give the stationary value of current.

Although there was a considerable difference in the speeds required by lamps having different numbers of loops in the filament, it was possible to find for every lamp tested a speed at which the current change reversed in sign. Furthermore, in every case the return of the current to the stationary value occurred at a speed which can be used in practice.

Possible Errors Introduced by Rotation

The accompanying table shows the errors in efficiency, and the consequent errors in life values, introduced by measuring candle-power and watts while the lamp is rotating tip up and also tip down. The values given are the results of photometric measurements made on a 750-watt, 115-volt nitrogen-filled lamp having nine anchor wires.

DATA ON ERRORS IN EFFICIENCY AND LIFE VALUES

Position of Lamp	Speed in R.P.M.	Rated Volts for 0.70 Watt per Candle, Lamp Rotating	Watts per Candle at Rated Volts; Lamp Stationary, Tip Down	Per Cent Error in Rated Volts	Per Cent Error in Rated Watts per Candle	Per Cent Life at Rated Volts; Lamp Stationary, Tip Down
Tip down..	0	115.0	0.700	0.0	0.0	100
Tip down..	35	115.0	0.700	0.0	0.0	100
Tip down..	70	113.5	0.718	1.3	2.6	121
Tip down..	120	112.8	0.726	1.9	3.7	131
Tip down..	180	109.9	0.760	4.4	8.6	184
Tip up....	0	113.8	0.713	1.0	1.9	115
Tip up....	14	113.8	0.713	1.0	1.9	115
Tip up....	70	110.1	0.757	4.3	8.1	178
Tip up....	120	107.4	0.793	6.6	13.3	252
Tip up....	180	104.4	0.837	9.2	19.6	375

On account of the increased efficiency of this lamp caused by rotation, for example, at 70 r.p.m. tip down, it was found to have a specific consumption of 0.7 watt per candle at 113.5 volts instead of at 115 volts as found at zero speed with the tip down. If, therefore, the lamp had been photometered at the factory while rotating at this speed, it would have been rated at 113.5 volts and would have been operated on the life rack at 0.718 watt per candle instead of 0.7 watt per candle and would have had a life 21 per cent greater than would be expected from the rating. If, however, it had been photometered with the tip up at 180 r.p.m. (as is sometimes done in practice), it would have been rated as

having a specific consumption of 0.7 watt per candle at 104.4 volts. If put upon the life rack at this voltage, it would operate at 0.837 watt per candle instead of 0.7 watt per candle and give a life 275 per cent in excess of normal. In other words, a long life performance is fictitious at the given specific consumption rating, or the consumption rating is fictitious for the given life. This holds true if the specific consumption is determined at any speed above that at which the current and candle-power have the same value as when the lamp is stationary with the tip down. For this lamp the particular speed is 35 r.p.m. For speeds below this value with the tip down, the specific consumption rating would be too high and the life value would be lower than expected from the rating.

Miscellaneous Tests

The following tests were made with a view to finding the cause of the variations observed in this type of lamp:

(1) To determine what effect external cooling of the bulb would have upon the current, a draft of air was driven against a 1000-watt lamp by means of an electric fan and a series of measurements of current were made at different speeds with "air on" and "air off." It was found that at every speed, including zero speed, there was a measurable increase in current due to the cooling effect of the fan, but that this increase was very small in comparison with the decrease in current due to the rotation of the lamp. Hence the decrease in current cannot be attributed to, and is only slightly affected by, external ventilation of the bulb by rotation.

(2) A 100-watt vacuum-type tungsten lamp with coil filament similar to that of the gas-filled lamp and similarly mounted in the bulb when rotated exhibited none of the changes observed with the gas-filled lamp. The same was found to be true in the case of a 500-watt vacuum-type tungsten lamp with straight filament mounted in the usual manner. The gas must therefore be the principal disturbing element which affects the changes observed in the gas-filled lamp.

(3) To determine the effect of possible distortion of the filament upon the candle-power in the horizontal plane, candle-power measurements at various angles with the vertical were made upon the 1000-watt lamp rotating with the tip down. first at a speed of 45 r.p.m. and then at a speed of 200 r.p.m. This is lamp *A* of Figs. 1 and 2. There was practically the same percentage increase in candle-power at every angle when the lamp was rotated at the higher speed, and hence the spherical reduction factor was not appreciably changed by rotation, being about 0.86 in both cases.

(4) Another test was made to determine whether or not the earth's magnetic field had a noticeable effect. This was done by placing the lamp in the middle of a solenoid having a field strength of about 500 gausses, and the current in the lamp was observed when the current in the solenoid was thrown on and off, both with the lamp stationary and rotating, but no change due to magnetism was detected.

Explanation of the Variations Observed in Current and Candle-Power

The results of these tests indicate quite conclusively that practically the whole of the effect observed in the change in current, candle-power and efficiency is due to a change in the convection currents of the gas within the bulb. At low speed, as seen above, there is an increase in the current over the stationary value for all voltages, the greater percentage increase being at the low voltages. At high speed there is a decrease in current from the stationary value for all voltages, the greatest percentage decrease being also at low voltages. At low values of voltage when the lamp is stationary there is a considerable difference in temperature between the gas at the top and bottom of the bulb. Very low speeds of rotation disturb the steady current of hot gas which is rising in the center and flowing down at a distance from the axis, and the result is a lowering of the temperature of the gas about the filament. As the filament has a positive temperature-resistance coefficient, the resistance decreases and consequently the current increases at constant voltage. At high values of voltage the mean temperature of the gas is higher, and consequently the temperature of the filament is reduced in a lesser degree by rotation and the change in current, though positive, is less than at low voltage.

On the other hand, when the lamp is rotated at high speed the cooler gas at the bottom of the bulb is thrown out by centrifugal force and the hot gas tends to remain near the center, thus considerably retarding the convection currents which cool the filament. The result is an increase in the efficiency of the lamp and a decrease in the value of the current. At high voltages the mean temperature of the gas is higher and the retarding effect due to centrifugal force is decreased, and hence the change in current due to rotation is less than at low voltages.

The cooling effect of the gas is opposed by the heating effect of the current. At low speeds the former predominates, at high speeds the latter. Hence at low speeds the temperature of the filament is lowered and consequently the candle-power is decreased. At high speeds the temperature of the filament is raised, and hence there is an increase in the candle-power.

Photometry of Gas-Filled Incandescent Lamps

In the *Electrical World* for Nov. 21, page 992, there appears an abstract of a short paper on "The Photometry of Gas-Filled Incandescent Lamps," read Nov. 12 before the New York Section of the Illuminating Engineering Society by Dr. C. H. Sharp. In this abstract mechanical distortion of the filament is given as one of the causes of the increase observed in candle-power when the lamp is rotated. We found, however, as stated above, that the filament of a 1000-watt lamp having seven anchor wires was distorted very little if any when the speed was increased from 45 r.p.m. to 200 r.p.m. and we doubt if that effect generally is appreciable. We found, furthermore, that the change in candle-power was fairly large in the opposite direction at low speeds and low voltage and null at a particular intermediate speed.

It is stated also that series, or constant-current, lamps show small or negative increase in candle-power per watt. We found this to be true for *all* lamps, however, when the speed is below a certain value. This value of the speed is low for some lamps and high for others, seeming to depend upon the number of anchor wires supporting the filament. Had Dr. Sharp used a higher speed, it is quite probable that he would have found an increase instead of a decrease in candle-power per watt of the lamps referred to. It is evident that when held at constant current any gas-filled lamp will change in candle-power more rapidly with changes of speed than when held at constant voltage.

It is stated further in this abstract that the variations observed do not appear to follow any definite law. We found, however, that the lamps tested experienced changes of candle-power with speed which were exceedingly reproducible and follow the curves shown very closely on successive trials.

The authors acknowledge their indebtedness to Dr. E. B. Rosa for his kindly interest and valuable suggestions, and to Mr. H. B. Sinelnick for efficient assistance in the laboratory work.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods and Current Practice Among Successful Utilities

Advertising the Low Cost of Electric Service

An unusual advertisement run by the Ohio Light & Power Company, Newark, Ohio, in a local newspaper, listed the actual bills rendered 1000 citizens of Newark for electric-lighting service during the month of September. "The Table That Tells a Tale," as the advertising man puts it, read as follows:

$0.50 to $0.60	303	$1.25 to $1.50	101
0.60 to 0.70	75	1.50 to 1.75	57
0.70 to 0.80	51	1.75 to 2.00	59
0.80 to 0.90	57	2.00 to 3.00	67
0.90 to 1.00	83	3.00 to 5.00	46
1.00 to 1.25	86	More than $5.00	15

A number of these consumers were using electric irons, toasters, vacuum cleaners and other appliances. The advertisement attracted much attention locally as proving the relatively low cost of electric service.

The Physician's Electric Phaeton

Every city physician who uses an automobile in making professional calls could drive an electric vehicle to advantage, declared Mr. L. E. Hamburg, Chicago, himself an electric-car user for fourteen years, at a recent luncheon of the Chicago Section, E. V. A. Compared with the gasoline car, the doctor who drives to his patient's residence in an electric car enters the house with his hands immaculate, his person free from odors of gasoline and lubricating oil, and his clothing neatly arranged rather than set awry by some impromptu repair to the power plant of his car. Such little details in the personal appearance of the doctor are important in the sick-room. Physicians appreciate this fact and at once recognize the value of the electric car when its advantages are called to their attention. Mr. Hamburg predicted that an electric-vehicle campaign among Chicago physicians who drive gasoline cars would promptly result in making all of them users of "electrics."

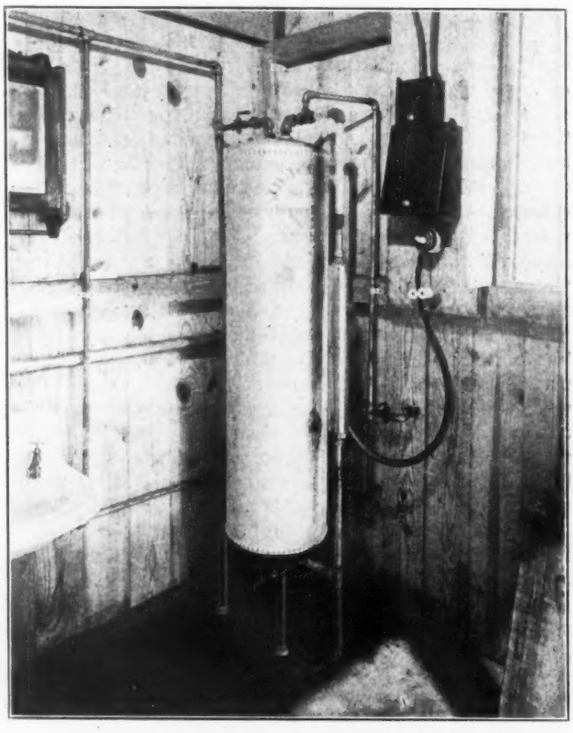
Two Hundred Houses Wired in Sixty Days

With no line or transformer expense the Springfield (Mo.) Gas & Electric Company has added 200 new residence customers to its circuits in sixty days. The success of the campaign is largely accounted for by the fact that the company's basic wiring offer included only a few outlets, one for a drop lamp in the kitchen, another for an electric iron, and inexpensive fixtures in other rooms. So slight was the cost of such work that owners and renters of even the smallest houses were unable to forego the opportunity to secure electric service. Although these installations at first do not represent attractive connected loads, it has been found that the electrical progressive contractors in the city are continually adding a lamp outlet here and there, making the customers by degrees more profitable to the central station. Mr. S. R. Gallagher, new-business manager for the electric service company, uses an appropriate and catchy phrase in expressing the central idea of the campaign. He says: "Just get the man's feet wet; don't try to drown him."

Electrically Heated Water for Beef Importer

Electrically heated water is employed by the Houston Steamship Company, Brooklyn, one of the largest importers of Argentine beef, in its employees' lavatories and for cleaning meat skids, trucks and skins. The apparatus for raising the temperature of the water is shown in the accompanying illustration. As hot water had to be used for only short periods and as no gas pipes were installed in or near the place where the water was required, it was estimated that the electrical equipment would be cheaper in the long run than boilers heated by gas or coal.

An ordinary 50-gal. tank is employed with a 3-kw electric heater surrounding a pipe leading from the top to the bottom of the reservoir. When the electric circuit is closed hot water rises in the vertical pipe and



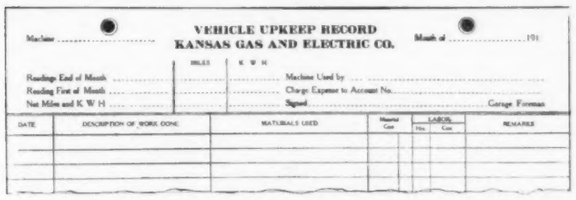
ELECTRIC HEATER USED BY BEEF IMPORTER

is replaced by cold water from the bottom of the tank, thus producing a downward current of water in the tank and an upward flow in the heater pipe. Pipes tapping the top of the tank convey the hot water to the lavatories and hot-water faucets.

In the winter about 25 gal. of hot water is required for two and a half hours each day. In the summer months from 60 gal. to 75 gal. is used over twice this period. The difference in consumption is accounted for by the fact that skins cannot be washed in the winter as the water would freeze upon them. The Edison Electric Illuminating Company of Brooklyn, which furnishes electricity for operating the heater, charges for the energy at its regular motor-service rate.

Savings Through Electric-Vehicle Operation at Wichita, Kan.

Electric vehicles of three sizes are being used successfully in the construction and the maintenance departments of the Kansas Gas & Electric Company at Wichita, Kan. Cost data which have been kept carefully by Mr. H. S. Sladen, manager of the company, since the purchase of these machines show that the electric trucks do the work required by the company at less


VEHICLE UPKEEP RECORD
KANSAS GAS AND ELECTRIC CO.

FORM OF RECORD USED IN WICHITA GARAGE

expense than any of its gasoline-driven machines. The trucks which the Wichita company has adopted for its use are of the 2-ton, 1-ton and 750-lb. sizes.

Using the largest truck on construction work, it has been found that this car can supply the needs of two or three line gangs, hauling the men and the construction materials, including poles, loaded on a dolly-type trailer. The 1-ton truck is used for answering trouble calls, for

TABLE I—COST OF OPERATION OF GENERAL VEHICLE COMPANY 2-TON ELECTRIC TRUCK

Month	Kw-hr. Used	Miles Traveled	Kw-hr. per Mile	Maintenance			Energy Cost at 3 Cents per Kw-hr.	Total Cost	Cost per Mile, Cents	
				Labor	Material	Total			Energy	Total
1912										
Jan.	253	331	0.76	.....	.....	.....	$7.59	$7.59	2.3	2.3
Feb.	180	229	0.79	$4.22	.....	$4.22	5.40	9.62	2.4	4.2
March.	159	256	0.62	.....	.....	12.88	4.77	17.65	1.9	6.9
April.	375	317	1.18	4.22	.....	3.00	11.25	14.25	3.5	4.5
May.	380	302	1.26	12.88	.....	2.38	11 40	13.78	3.8	4.6
June.	646	383	1.69	5.12	.....	5.12	19.38	24.50	5.1	6.4
July.	522	376	1.39	13.19	.....	13.19	15.66	28.85	4.2	7.7
Aug.	700	357	1.96	3.42	.....	3.42	21.00	24.42	5.9	6.8
Sept.	451	308	1.46	4.15	.....	4 15	13.53	17.68	4.4	5.7
Oct.	558	313	1.78	4.27	.....	4.27	16 74	21.01	5.3	6.7
Nov.	647	256	2.53	11.01	.....	11.01	19.41	30.42	7.6	11.9
Dec.	596	312	1.91	14.17	.....	14.17	17.88	32.05	5.7	10.3
1913										
Jan.	583	229	2.55	14.90	.....	14.90	17.49	32.39	7.6	14.1
Feb.	1000	260	3.85	3.09	$1.25	4.34	30.00	34.34	11.5	13.2
March.	671	431	1 56	1.10	.....	1.10	20 13	21.23	4.7	4.9
April.	462	337	1.37	.....	0 19	.19	13.86	14.05	3.1	4.2
May.	418	300	1.39	2 68	11.81	14.49	12.54	27.03	8.5	18.3
June.	365	Est. 200	Est. 1.83	5.18	2.86	8.04	10.95	18.99	5.5	9.5
July.	527	Est. 210	2.51	1.40	0.07	1.47	15.81	17.28	7.5	8.2
Aug.	539	395	1.36	4.58	12.60	17.18	16.17	33.35	4.6	8.4
Sept.	484	443	1.09	2.80	110.18	112.98	14.52	127.50	3.3	28.8
Oct.	634	480	1.32	2.48	43.29	45.77	19.02	64.79	4.0	13.5
Nov.	955	517	1.85	5.92	36.77	42.69	28.65	71.34	5.5	13.8
Dec.	489	316	1.55	1.54	.....	1.54	14.67	16.21	4.6	5.1
1914										
Jan.	612	353	1.76	4.36	0.84	5.20	18.36	23.56	5.2	6.7
Feb.	551	282	1.95	14.10	72.42	86.52	16.53	103.05	5.9	36.5
March.	284	181	1.57	1.44	76.94	78.38	8.52	86.90	4.7	48.0
April.	564	442	1.28	1.34	.....	1.34	16.92	18.26	3.8	4.1
May.	505	376	1.34	.43	.....	.43	15.15	15.58	4.0	4.1
June.	395	327	1.21	1.36	5.06	6.42	11.85	18.27	3.6	5.6
July.	314	253	1.24	13.48	5.00	18.48	9.42	27.90	3.7	11.0
Aug.	600	499	1.24	1.32	19.26	20.58	18.00	38.58	3.6	7.2
Sept.	813	498	1.63	2.79	41.00	43.79	24.39	68.18	4.9	13.7
Total.	17,232	11,069	52.78	$162.94	$439.54	$603 64	$516.96	$1120 60	161.9	356.9
Average.	522	336	1.59	$4.91	$13.3	$18.28	$15.62	$33.90	4.9	10.8

doing general maintenance work and for hauling men and material for short line extensions. Wagons of the 750-lb. size were recently purchased for both the gas and the electric meter departments, but these machines have not been in service long enough to provide reliable operating data. For the larger trucks, however, the complete records as they were kept by the company are given herewith. The company's record form used in the garage is also reproduced.

A brick building which was formerly the Wichita power house now serves as the company's garage. The garage was established and is maintained primarily for the company's own trucks, but the company's men also take care of a few customers' vehicles, somewhat reduc-

TABLE II—COST OF OPERATION OF GENERAL VEHICLE COMPANY 1-TON ELECTRIC TRUCK

Month	Kw-hr. Used	Miles Traveled	Kw-hr. per Mile	Maintenance			Energy Cost at 3 Cents per Kw-hr.	Total Cost	Cost per Mile, Cents	
				Labor	Material	Total			En-ergy	To-tal
1913										
Jan.	767	431	1.70	$25 14	.....	$25.14	$23 01	$48.15	5 1	10.7
Feb.	933	450	2.07	2 34	$2.97	5.31	27.99	33 30	6 2	7.4
March.	625	616	1 01	1.64	0 48	2 12	18.75	20.87	3 0	3.4
April.	449	554	0.81	0.42	0 89	1.31	13.47	14.78	2 4	2 7
May.	419	523	0 80	5 17	13.84	19 01	12 57	31.58	2 4	6 0
June.	484	722	0.67	0.28	1.82	2.10	14.52	16.62	2.0	2.3
July.	483	749	0.64	0.56	0.07	0.63	14.49	15.12	1.9	2.0
Aug.	386	606	0.64	0 84	5.38	6.22	11.58	17.80	1 9	2.9
Sept.	483	688	0.70	2 0.	3.40	5.48	14 49	19.97	2 1	2 9
Oct.	622	754	0.82	1.74	2.47	4.21	18 66	22.87	2.5	3.0
Nov.	461	572	0.81	13.24	35.34	48.58	13.83	62.41	2.4	10.9
Dec.	663	669	0.99	2.56	14.84	17.40	19.89	37.29	2.9	5.6
1914										
Jan.	530	572	0.93	12.16	1.12	13.28	15.90	29.18	2.8	5.1
Feb.	671	579	1.16	2 08	0.90	2.98	20.13	23.11	3.5	4.0
March.	677	481	1.41	0.22	.....	0.22	20.31	20.53	4.2	4.3
April.	302	379	0.80	3 02	52 21	55 23	9 06	64.29	2.4	18.3
May.	609	700	0.87	1.88	4 60	6.48	18.27	24.75	2.6	3.5
June.	414	736	0.56	.....	0.73	0.73	12.42	13.15	1.7	1.8
July.	551	688	0.80	5.78	6.95	12.73	16.55	29.28	2.4	4.2
Aug.	500	715	0.70	6 0.	54.95	61.0.	15.00	76 01	2.1	10.6
Sept.	767	831	0.92	4 0.	1.98	6.06	23.01	29.07	2.8	3.6
Total.	11,796	13,035	19.81	$91.31	$204.94	$296.23	$353.90	$650.13	59.3	115.2
Average.	562	619	0.94	$4.35	$9.76	$14.1	$16.85	$30.95	2.7	5.5

ing the garage labor charges per vehicle. A further saving could be effected here by taking in more outside trucks without increasing the present number of garage workmen.

The data tables are largely self-explanatory. It should be noted, however, that the data in the column headed "Kw-hr. Used" were read from a meter on the direct-current side of a motor-generator set and therefore do not take into account any losses in the charging equipment, except the charging rheostat, which is between the meter and the truck. Figures in the "Maintenance" column fluctuate rather widely, owing to high labor charges when trucks were being overhauled or to the cost of making repairs of broken axles, motor or controller troubles, etc. Where "Maintenance Material" charges appear high the cause of the increase is generally traceable to the renewal of one of an unsatisfactory set of tires.

Showing Up the Friction-Load Losses

"The manufacturer who runs his entire equipment up to its full capacity every minute of the day and every day in the year is a curiosity," said Mr. R. A. MacGregor, Toledo, Ohio, before the recent convention of new-business men at Cincinnati. However, motor-service salesmen are continually meeting manufacturers who think they are doing this. When pointing out to these men the saving to be made by eliminating friction, the argument is often advanced, "Why, that shaft takes no power; I can turn it by hand." It is well to meet this argument by saying, "Is that so? Well, let's see you turn it 250 times in a minute." That suggestion generally shows the friction load more nearly in its true light. Even a 1-hp friction waste, if allowed to continue nine hours a day, twenty-five days in the month and twelve months in the year, costs as much as the interest on $1,000, if energy is purchased at 3 cents per kw-hr.

Pointed Paragraphs on Public Policy

During nineteen years' experience in utility work Mr. D. L. Gaskill, of Greenville, Ohio, has observed that there are certain definite factors which tend to produce congenial relations between the public and the utility companies. In his characteristic epigrammatic style Mr. Gaskill recently gave some of his thoughts on this subject to the members of the Indiana Electric Light Association at their convention in Indianapolis. The following paragraphs are excerpts from his address:

"To-day to the alert public utility manager the public policy of the company is a distinct and well-defined part of his organization, calling for expenditure of time and money and bringing greater results, both good and bad, than any other department."

"The interest of the public in the utility is confined to two things—service and rates. When the utility has made the first of these perfect and the latter reasonable, and has convinced the public that it has done so, the public policy of that company is a pretty well-settled question.

"After nineteen years of experience I have come to the conclusion that a company should have rules covering but two points, the date for paying bills and its minimum charge. If there is anything a good, live, energetic American likes to do it is to break a rule. Always remember that a good many of your rules will not be understood by your customer. He will not even know about most of them, and when you call attention to an infraction of them he does not believe that you have law-making power even if you are a 'natural monopoly.' He may comply and even stand punishment, but he is an enemy from that time forward.

"I know of some cases in which regulations controlling service in Western towns are made by men in Eastern cities, and the fit they make is wondrous to behold. It is comparable to an elephant's blanket for a Shetland pony. Straightforward and open dealing, with few rules, will produce less discrimination than lots of rules and part of them broken."

"A central-station manager would better spend months educating his city council in the costs of street lighting, and then make a contract on the basis of cost plus a reasonable profit, than to play the game of catch-as-catch-can and get caught in the end by the town putting in a municipal plant.

"Street-lamp outages which cause people to wade unwittingly into muddy places are not conducive to the making of friends for the company. A globe half full of bugs will not interfere with the working of the arc, but it will interfere seriously with the placid operation of the mind of the citizen."

"A disordered liver and a utility manager have no business being incorporated in the same man. They won't mix. The man who can receive a complaint as if it were a pleasure is the pearl we are seeking. No other is worth the price of his wages.

"Not all complaints are worthy, not all are well founded, but all persons having them think that they are, and to receive them, attend to them, and make the complainant think he has attained his end, is the art we should cultivate.

"The 'trouble shooter' is another factor to be considered. Sometimes in disposition he is a cross between a grizzly bear and a wildcat, and the amount of dissatisfaction he distributes is proportional to the amount of work he does. The brightest, most pleasant and tactful man on the force is none too good for this work.

"I believe that it would be a good thing for utilities if a law could be passed requiring the public utility manager to call upon every business customer at least once a month and ascertain if his service is satisfactory."

Illumination and Wiring

Conduit Wiring on Plaster-Board Partitions and Ceilings

BY G. M. DURFEE

So-called "two-inch partitions" are now being constructed in many buildings, particularly in those of fireproof construction. These partitions are made either by plastering on metal lathe or on plaster-board surfaces that are supported on steel studding of small

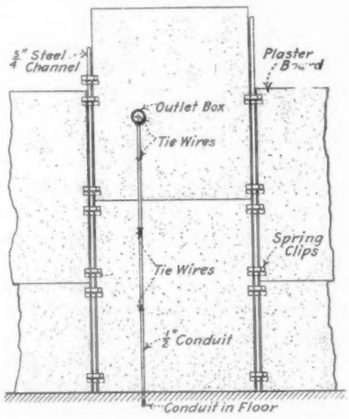


FIG. 1—OUTLET BOX AND CONDUIT WIRED TO PARTITION

angle or channel sections. In the construction of a plaster-board partition channels ¾ in. deep are used to carry the plaster-board slabs, which are held to the channels with steel clips as shown in the illustrations. Because of the space economy of partitions of this type they are being utilized in a great many cases for the subdivision of office-building floor areas. It is because of their present and coming popularity that the wireman should be familiar with methods of carrying circuits within partitions of these types.

The partitions, when completed, are practically solid and comprise only fireproof materials, namely, steel and plaster. It is obvious, then, that the conduit method is the only one that is permissible within these thin partitions. Either rigid or flexible conduit can be used. As a rule, it will be more economical to use rigid conduit where it is not necessary to make a great number of turns and offsets in the conduit run. However, in some cases where the route of the run is very irregular flexible conduit may be the more economical. Inasmuch as the partition will dry out before the conductors are

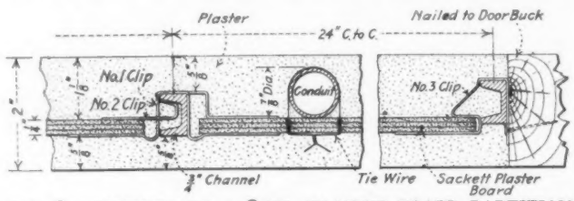


FIG. 2—CONDUIT IN A 2-IN. PLASTER-BOARD PARTITION

pulled in, it is unnecessary to use leaded, flexible metallic conduit. The unleaded conduit will be passed by the Underwriters' inspectors for any installation in a location where it will not be permanently damp.

Fig. 1 shows the method of installing a run of conduit and a bracket outlet box on a plaster-board partition. The conduit is installed on the partition after the plaster-board slabs have been placed. The conduit is held to the plaster board with tie wires, which, as shown in Fig. 2, pass around the conduit and through

holes in the board and are twisted together on the rear side of the board with a pair of pliers. This will draw the conduit tightly against the board. The holes for the tie wires in the plaster board can be made with a small twist drill turning in a bit brace. The outlet box is also supported to the plaster board with a tie wire.

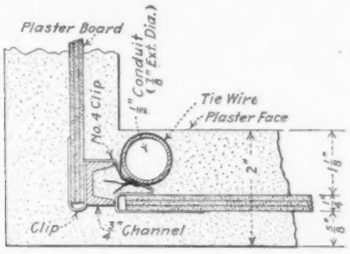


FIG. 3—CONDUIT BOUND TO CORNER CLIPS WITH TIE WIRES

It will be noted from Fig. 2 that the plaster board does not lie exactly in the center of the 2-in. partition, although the channel studs do lie in the exact center. There is a distance of ⅝ in. between the plaster board and one face of the partition, and of 1⅛ in. between the face of the plaster board and the other face of the partition.

Inasmuch as ½-in. conduit is a trifle over ⅞-in. external diameter, it is necessary to place the conduit on the 1⅛-in. side of the plaster board, as suggested in Fig. 2. It is necessary to use a shallow outlet box having a depth not greater than 1⅛ in. for this work. If necessary, the box can be blocked out from the plaster board with small sticks of wood so that its outer edge will lie flush with the finished plaster line.

It is frequently possible to erect a conduit riser in a plaster-board partition at a corner or near one of the steel studs, as shown in Fig. 3. In such cases the conduit can be held with tie wires, as shown in Fig. 3, to the steel clips that clamp the plaster boards in place to the channel studs.

An outlet in a plaster-board ceiling can be arranged as shown in Fig. 4. There is only ⅝ in. finished plaster between the lower face of the plaster board and the finished plaster surface, so that there is scarcely room in this space for an outlet box. A ceiling plate might be used if the conduit runs were such that they could enter at the back of the plate. In most cases, however, the conduit runs will be horizontal, as shown in Fig. 4, and must enter the sides of the boxes. It will then usually be necessary to use 2¼-in. boxes in plaster-

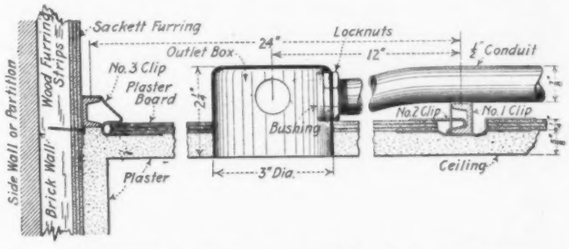


FIG. 4—OUTLET BOX IN A PLASTER-BOARD PARTITION

board ceilings, which will permit the conduit to enter the side knock-outs.

If an electrolier is to be supported from an outlet box in a plaster-board ceiling, it will be necessary to provide additional support for the outlet box to enable it to sustain the weight of the electrolier. This support can be provided by arranging a bridge across a couple of the channel section beams, or by arranging a piece of rod or strap iron vertically over the center of the box to some member above, so that it will be in tension when a stress is imposed on the box. Frequently a piece of No. 6 soft-iron wire can be used for this tension member. It can be threaded through and tied in the screw-holes in the bottom of the outlet box and made fast over a beam or around some member that is placed directly above the outlet box.

Illumination of a Motion-Picture-Theater Entrance

Knowing that an intensely illuminated entrance alongside of faintly lighted store fronts would attract attention, the proprietor of the motion-picture theater shown in the illustration has installed eight 1000-watt gas-filled lamps and two flame-arc lamps in the theater entrance. All the lamps are inclosed in diffusing globes, six of the gas-filled units being suspended from the ceiling of the entrance and two from brackets attached to the building front. An electric sign placed at right

BRILLIANTLY LIGHTED THEATER FRONT

angles to the sidewalk informs persons on the street of the location of the theater.

Electrical energy for the purpose of operating these lamps and the picture-projecting apparatus is furnished to the proprietor of the theater by the Edison Illuminating Company of Brooklyn, N. Y.

Trainman's Storage-Battery Lamp

On that division of the Santa Fé Railroad which runs between Independence and Wellington, Kan., an ingenious flagman has changed his oil lantern into a modern electric lamp. To avoid purchasing batteries, however, he has connected the lantern through a long flexible cord to one of the lamp sockets used ordinarily for lighting the coach platform. He employs the lantern only for signaling the engineer from the rear platform of the train, and hence in actual use does not need to take the lantern far from the car. The idea of this progressive employee may possibly commend itself to other trainmen who are able to substitute electricity for kerosene.

RECENT TELEPHONE PATENTS

Automatic Exchanges and Apparatus

In calling a telephone user with automatic connecting apparatus it is usually necessary to turn a dial through definite angles of rotation, and hence for accurate calling there must be some indication of the signal through the sense of touch, sound or sight. To eliminate this disadvantage Messrs. W. M. Haralson and J. F. Pilkington, of Dallas, Tex., have patented the idea of attaching a small electric lamp to the center of the dial, which can be illuminated when the receiver hook is raised.

An improvement in dial signaling and connecting devices has been patented by Mr. C. A. Andersen, of Chicago, who has assigned his patent to the Andersen Electric & Manufacturing Company. The dial can be mounted on a bracket attached to the top of the subscriber's telephone set. Within the base of the case is a manually operable switch for changing the circuit connections so that the dial may be employed with either magneto or central-energy systems.

Mr. A. H. Dyson, of Chicago, has devised a system of automatic telephone operation, the patent for which has been assigned to the Kellogg Switchboard & Supply Company. With this system a connection is completed by the apparatus selecting the calling line first and the called line last. Two types of selectors and two sets of master switches are used to select the calling line. The primary master switch being so set that a non-busy primary selector is connected for operation when a call is sent in, the primary switch will select that bank of secondary selectors in the contact bank from which the calling line radiates. By means of the secondary master switch in that bank a secondary selector is connected to complete the call. With a semi-automatic system this results in connecting the calling line with a manual switchboard where an operator may complete the connection.

Improved Telephone Instruments

High-voltage energy can be employed with the transmitter recently patented by Mr. J. Redding, of Malden, Mass. The transmitter is provided with a large number of small microphone buttons of the granular type, all of which are connected in series. The buttons are arranged symmetrically on the diaphragm of the transmitter.

A simple method of insulating one terminal of the transmitter from the frame has been patented by Mr. E. B. Craft, of Hackensack, N. J. The stationary stud fits snugly in an insulating washer which is forced into a counter-bored hole in the bridge. A clamping nut on the projecting end of the stud binds all parts together.

To increase the sensitivity of transmitters and receivers, Mr. S. G. Brown, of London, England, has developed a method of mounting the diaphragms so that they do not have to be clamped at the periphery. One method is to support the diaphragm at the electrode mounting only, and the other is to employ a magnetic reed or tongue which projects in front of the pole pieces. The diaphragms are made of extremely thin aluminum and are formed to follow the contour on the inclosing mouthpiece or earpiece respectively.

Mr. A. Rosenberg, of London, England, has patented an adjustable receiver which includes a magnet core and coil mounted on a thin plate which is dished outwardly. By turning a screw stud fastened to the middle of the dished portion and extending through the rear of the casing the dish can be flattened, thereby lengthening the air-gap between the cores and the diaphragm. A pointer on the screw stud indicates the length of the air-gap.

Letter to the Editors

Sulphur as a Conductor

To the Editors of the Electrical World:

SIRS:—In your issue of Nov. 7, 1914, you called attention to the remarkable similarity in the physico-chemical properties of selenium and sulphur, and stated that one would expect to find sulphur a conductor when under the influence of light. In this connection recent work of the writer showing that sulphur becomes a conductor may be of some interest.

Sulphur was first found by the writer to give off electrons under the influence of light of a longer wavelength than 3200 Angstrom units while experimenting in the Sloane Physical Laboratory of Yale University in 1911. Inasmuch as the eye can detect violet rays down to about 3800 Angstrom units, it is quite possible that sulphur is photoelectric throughout a small part of the visible region.

During further experiments on the electrical properties of sulphur carried on by the writer at the Massachusetts Agricultural College it was found that sulphur becomes a conductor under the influence of light. A report was made of this discovery to the American Physical Society under the title of the "Actino-dielectric Effect of Sulphur," as will be seen by referring to the *Physical Review*, Vol. 36, page 336, 1913, and to page 139, Vol. 34, *American Journal of Science*, 1912.

The experiment was conducted as follows: Sulphur was placed between two circular disks of brass. One disk was perforated so that light could fall on the sulphur. The perforated disk was so arranged that the terminal of a battery could be attached to it. The other disk was attached to an electrometer. The disks were inclosed in a brass chamber so arranged that it could be evacuated. The leads passed out of the chamber through amber plugs. Opposite the disk with holes in it was a glass window. As glass cuts off the ultra-violet rays which cause brass to give off electrons, no electrons could be produced except from the sulphur. The sensitiveness of the electrometer was about 1500 mm per volt. The source of light was a portable carbon arc lamp. When there was no light on the sulphur 100 or more volts could be impressed on it without causing the electrometer to move; that is, the sulphur was an insulator in the dark. However, the instant light fell on the sulphur the electrometer began to deflect. The direction of the deflection depended on whether the perforated disk was charged positively or negatively, thus showing the phenomenon to be one of conduction. An effect similar to this observed by Lenard in examining the phosphorescent alkaline earth sulphides was called by him the actino-dielectric effect.

The phenomena of the actino-dielectric effect should be clearly distinguished from the photoelectric effect. In the photoelectric effect the perforated disk is not in contact with the material and the deflection of the electrometer is always in one direction, and that is the one caused by the accumulation of a positive charge.

In order to obtain the photoelectric effect of sulphur a good vacuum is necessary, while the actino-dielectric effect can be obtained at atmospheric pressure. There is probably a direct relation between the photoelectric and actino-dielectric effect of sulphur. An investigation started some time ago by the writer on this subject at the Davy-Faraday Research Laboratory of the Royal Institution, London, was discontinued for various reasons. The fatigue effects somewhat complicate the problem, but the investigation of it would surely lead to very interesting results.

Pittsburgh, Pa. CHESTER A. BUTMAN.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

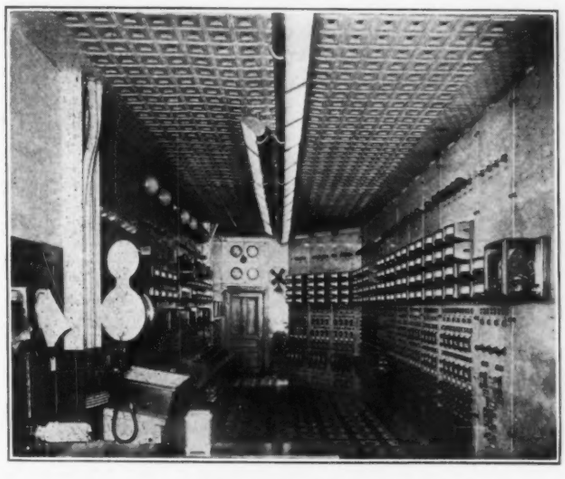
Accident Caused by Mouse in Oil Switch

An undersized mouse recently caused an unusual accident in the generating station of the United Water, Gas & Electric Company at Hutchinson, Kan. In some way the rodent got into an oil switch, and the assistant engineer tried to remove it without interrupting service on the line controlled by that switch. By accident the mouse came into contact with the switch terminals, thereby causing a short-circuit which burned a man quite severely, although not dangerously. Immediately afterward the chief engineer opened the main switch, thus quickly clearing the trouble, and then restored service. The oil switch on which the accident occurred controlled a lightly loaded motor circuit, and service to these customers was restored promptly.

It has been suggested that such accidents can be avoided by keeping the oil switches so inclosed that small animals cannot reach the live parts.

Illumination of Switchboards

If switchboards are lighted only by lamps placed along the tops of the panels, the lower portions of the board will be only faintly illuminated. To obtain a uniform distribution of light over the entire face of the board the lighting units may be arranged as shown in the halftone, which represents an installation at the Gold Street station of the Edison Electric Illuminating Company of Brooklyn, N. Y. In this station the switchboards are arranged parallel to each other on opposite

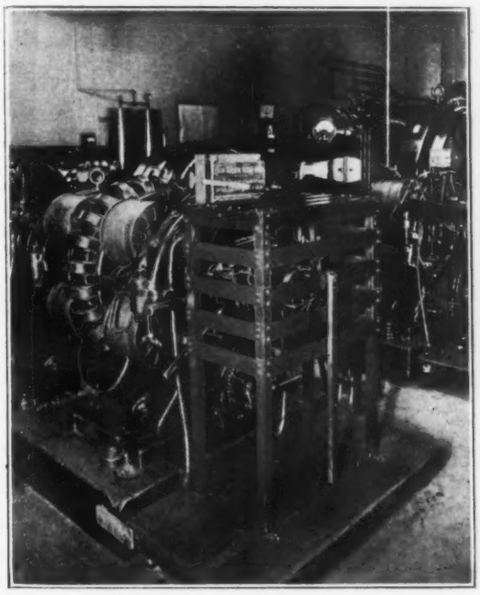


ILLUMINATION OF CENTRAL-STATION SWITCHING ROOM IN BROOKLYN

sides of the operating aisle and the lamps are installed in horizontal trough reflectors covered with diffusing glass. The reflectors are back to back, with the glass diffusers inclined so that the light is distributed over the panels of the switchboard. With this arrangement the lower portions of the board are illuminated practically as well as the upper part.

Safeguarding Employees Around Series Lighting Circuits

All generating and switching equipment connected with the series-lighting circuits in the stations of the Edison Electric Illuminating Company of Brooklyn is installed so that the employees are not subjected to any hazard. Although constant-current transformers have



A DANGER-REMOVING CONTRIVANCE

superseded brush-arc machines to a considerable extent, there are still a few of the latter installed in this company's stations. Steel frames have been placed around the overhung shafts carrying the commutators so that the operators will not come in accidental contact therewith. Platforms equipped with insulating legs are provided in front of each arc-circuit switchboard for the operator to stand on while connecting the various circuits. Although the switch plugs are tested periodically to see that they will not break down under high-voltage, the operators are required to wear rubber gloves and hold one hand behind them while inserting the plugs. The gloves are also subjected to periodic leakage tests.

Water Softening by Electrochemical Methods

Among the papers prepared for the meeting of the American Society of Refrigerating Engineers held recently in New York City was one by Mr. C. P. Landreth, of Philadelphia, calling attention to the fact that electricity will hasten chemical reaction and thereby improve the results obtained with boiler-feed-water softening compounds. To soften water it is analyzed in the usual way and the chemical compound determined which will precipitate the scale-forming compounds present in the water. For instance, calcium hydroxide is used to

remove calcium bicarbonate, sodium carbonate is employed to remove calcium sulphate, etc. After the softening compound has been added to the boiler-feed water, it is circulated past parallel electrodes which are placed close together in order that as much of the water as possible may be brought in contact with the surface of the plates. Because of its ionizing property electricity will separate the compounds into their components, thereby hastening the recombination to form precipitates which coagulate and are removed without difficulty.

Unaided by the addition of any energy, the reaction between calcium sulphate and sodium carbonate to form insoluble calcium carbonate and soluble sodium sulphate is ordinarily very slow, but if electricity be allowed to ionize the water containing these compounds the precipitate can be quickly removed. In a plant mentioned by the author of this paper, the calcium carbonate in solution was reduced to 3 grains per gallon, which is within 1/160,000 of the theoretical amount which would be held in solution, the electrolysis producing sufficient coagulation, so that the precipitate could be readily removed in filters. Ten million gallons of water per day was treated in this manner with a continuous power requirement of only 480 watts per 1,000,000 gal.

Combined Telephone and Telegraph Circuit for Operating Water-Power System

The system of telegraph circuits in combination with telephone lines as used by the Washington Water Power Company, of Spokane, Wash., has been in service about two years and from a standpoint of reliability and safety has proved entirely satisfactory. The conditions under which this system is used are as follows: Three hydroelectric stations and numerous substations are connected to the 60,000-volt system and all switching is under the direct supervision of a system operator at the main office in the city of Spokane. In all there are six telephone lines running into Spokane and the apparatus is protected by telephone insulating transformers with grounded neutral. Two of these lines extend to the Little Falls and Post Falls power stations and are respectively 28 and 26 miles long.

As an additional safeguard against telephone trouble it was thought advisable to install telegraphic communication between the system operator and the above-mentioned hydroelectric stations. The third generating station being in Spokane and only a few hundred feet from the office, telegraph connection was not deemed necessary.

Referring to the accompanying drawing, from the neutral of the primary side of the telephone transformers, the lines run overhead to the Spokane station, a distance of about 2 miles. At this station the line is connected to the positive Edison bus in series with the coils of a 250-ohm relay, the contacts of a 20-ohm relay and a 20-watt, 110-volt lamp. The coils of the 20-ohm relay are connected between the positive Edison bus and ground in series with a 10-watt, 110-volt lamp and the key, which is in the system operator's office. Also the contacts of the 250-ohm relay are connected in between the positive bus and ground in series with a 50-watt, 110-volt lamp and the sounder, which is also in the system operator's office. At the station there is a grounding switch which in extreme cases of storm could be closed to protect the instruments, but this would mean a voluntary interruption of the service at a time when it would probably be most needed, and it has so far never been necessary. The connection at the other end of the line in effect is exactly the same. The operator is at all times safe from lightning or interconnection between the telephone and the 60,000-volt transmission system.

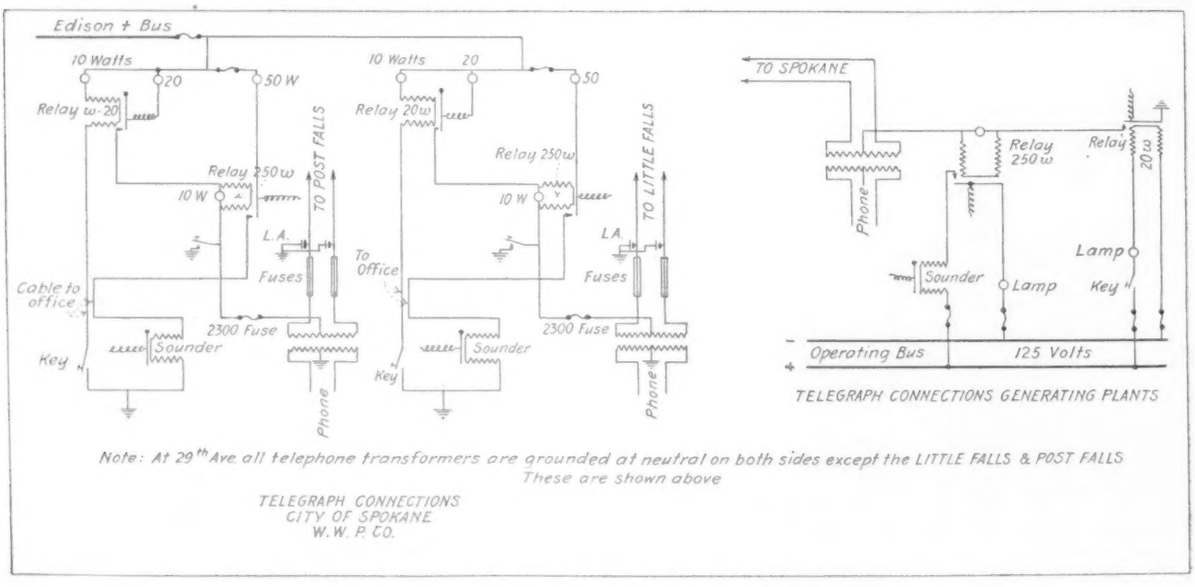


DIAGRAM OF TELEPHONE AND TELEGRAPH CONNECTIONS

Circuit-Breaker Location for Parallel Operation

When two compound-wound generators are connected for parallel operation and only one single-pole circuit-breaker is used on each machine panel, in which lead should it be located?

E. E. W.

The circuit-breaker should be placed in the armature lead connected to that side of the machine not associated with the series field coils. If it were placed in the other armature lead, an overload on one machine would merely cut out its series field circuit, thereby allowing the generator to continue to operate as a shunt machine. With the reduction in field flux caused by the loss of the series field current the machine would probably be driven as a motor, thereby still further overloading the rest of the generating equipment which is connected in parallel with it.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Mechanical Forces in Circuits Carrying Heavy Currents.—P. V. HUNTER.—The chairman's address to the Newcastle Section of the (British) Institution of Electrical Engineers. With the increasing size of generating and transmission systems there is a tendency for manifestation of the mechanical forces experienced by circuits carrying heavy currents. The stresses were first experienced as a matter of practical importance in the end-turns of turbo-alternators subjected to a short-circuit. The problem was complicated by the fact that the damage largely depended on the character of the short-circuit. A growing fault allowed the armature current to demagnetize the generator field, and excessive currents were not produced in the stator windings. As a result, there was difference of opinion among experienced engineers respecting the effect of short-circuits on alternators. In some cases they apparently stood up satisfactorily and in others not. The primary precaution is to brace the end-turns in a manner enabling them to withstand the mechanical forces. With the object of reducing the magnitude of the forces, reactance coils in series with the generator windings, preferably inserted at the star end of the windings, have been adopted, more particularly in the United States. This arrangement is to be recommended where the generators are wound for the pressure of transmission. It is, however, more usual at the present day to transmit at pressures for which generators cannot be satisfactorily wound, and in such cases a more satisfactory arrangement is to use a step-up transformer directly connected to the terminals of each generator, incorporating a substantial amount of reactance in the transformer windings. Serious mechanical forces accompanying the flow of current are by no means confined to the end-turns of alternators. Of all the electrical apparatus the transformer is that which is in a position to be subjected to the greatest mechanical stress from this cause. The author thinks that the majority of transformers manufactured to-day have inadequate provision against the mechanical stresses of short-circuit. That more trouble is not experienced is no doubt almost entirely due to the fact that the generating plant is not able to maintain full primary pressure on short-circuit. This protection will disappear with the growth of the generating system. While these remarks refer to ordinary voltage transformers, there is, however, little doubt that many series transformer failures, if properly traced to their source, are due to mechanical movement of the primary coils under heavy rush of current. The series transformer is in the unfortunate position of not being able effectively to limit the value of the current which can be passed through it. A sound mechanical construction of series transformer windings may, therefore, be regarded as necessary. In this connection the soundest arrangement is decidedly that in which the primary consists simply of a bar without turns. Their reliability from all points of view is so far superior to that of any other type that they should undoubtedly be used wherever possible. One curious effect of the mechanical stresses accompanying the flow of current is the tendency of knife-type disconnecting switches to open automatically under a heavy rush of current. The effect is similar to that which tends to increase the perimeter of a conductor forming a closed loop, and does not exist if the conductors above and below the switch are in line with it. So far as generators are concerned the addition of even a comparatively large reactance does not materially affect either the cost of the generator or its efficiency. In the case of reactors between busbar sections and on feeders, however, the conditions are different. The division of a network into a number of isolated sections very materially increases the cost and must be avoided except in the case of networks so large as to require a number of separate power stations. The disadvantage of sectioning a network is greater the higher the diversity of the load. The objection to the use of reactance at the power-station end of feeders is the increased effective voltage drop incurred. This depends on the power-factor of the load. The simplest way out of the difficulty is to supplement the reactance coil with a regulator in each feeder which can be adjusted to maintain the voltage constant at the far end of the feeder under any normal conditions of loading.—London *Electrician*, Dec. 4, 1914.

Lamps and Lighting

Street Lighting with Half-Watt Lamps.—L. BLOCH.—The conclusion of his article, the first part of which was recently abstracted in the Digest. In alternating-current distribution systems the small auto-transformer renders it possible to use the lamps under all conditions. Such transformers are small and inexpensive, their cost being $3.75. The efficiency is between 85 and 92 per cent. No-load losses are absent, since the transformers are disconnected on the primary side. A 100-watt lamp consumes 0.6 watt instead of 0.53 watt per cp, when the transformer losses are taken into consideration. The secondary emf of such transformers is usually 14 volts or 25 volts. Where it is desirable to reduce the illumination during the late hours of the night use is made of lamps with two filaments which are in circuit during the early hours of the evening, only one being used during the late hours. The change in the connections is made by a special switch which is so constructed that one filament is lighted during the late hours of one night and the other filament during the late hours of the next night and so on alternately. Lamps of this kind usually require three conductors, the three conductors of a three-wire system of 2×110 or 2×55 volts being used. However, it is possible to use only two conductors by employing special switching apparatus. Failure of a nitrogen-filled tungsten lamp during operation is relatively rare. It is generally replaced by a new lamp after 1000 hours since the candle-power is then usually decreased by 20 per cent, but one has considerable leeway. The chief decrease of candle-power (about 15 per cent) occurs during the first 600 hours. Further decrease is very slow. The decrease to 80 per cent of the initial candle-power occurs in about 950 hours, the decrease to 75 per cent only after 1200 hours. Before the candle-power had decreased by 20 per cent only 19 per cent of all of the lamps became defective. The initial specific consumption was 0.505 watt per hemispherical cp for a clear glass globe and with an

external reflector. The nitrogen-filled tungsten lamp is used for street lighting in Berlin and suburbs and various other German cities.—*Elek. u. Masch* (Vienna), Nov. 1, 1914.

Generation, Transmission and Distribution

Battery Reserve in Single-Phase Station.—W. T. KUMMER.—The first part of an article on the battery reserve employed in the Zurich lighting station. The station is supplied with energy from the Albula power station by means of three-phase currents which are converted from rotary converters into single-phase currents of the same frequency. The converter sets are also connected with storage batteries operated in parallel for reserve in case there should be a failure of the primary three-phase supply. The author discusses this arrangement and outlines the history of the electricity supply in Zurich, which has led to this particular arrangement.—*Schweiz. Bauzeit,* Nov. 21, 1914.

Power-Plant Testing.—W. M. SELVEY.—An abstract of a paper read before the (British) Institution of Electrical Engineers. The author deals generally with the testing of plant in central stations, particularly from the point of view of guarantees. The opinion is expressed that the accuracy of such tests is now fully up to requirements. The author deals in turn with boiler plant, turbo-generators, meters, condensers and air pumps, cooling towers, centrifugal pumps and fans. —London *Electrician,* Nov. 27, 1914.

Traction

Electric Railroad.—E. E. SEEFEHLNER.—The first part of an illustrated article on the electric railroad between Vienna and Pressburg. This new electric railroad had formerly been vigorously opposed, as it was thought that there was not enough traffic to justify the expense. But even during peace times so much traffic developed that the rolling stock had to be increased by 70 per cent. The road has proved even more successful during war. Each train had to carry morning and evening double loads. The trains are operated by electric locomotives, and the standard train consists of two cars, each with sixty passengers; but now trains are continually being run with four cars, each with 186 passengers. The schedule is nevertheless very regular. The single-phase locomotive has proved very successful, although the attendance had to be considerably reduced. Some locomotives have had to run 10,000 km (6000 miles) in a month. The director of the road, his son and his daughter have served as locomotive engineers in emergency cases. Within the cities of Vienna and Pressburg the direct-current system is employed. On the interurban line the single-phase system is employed at 15,000 volts or 16,000 volts. Where the different systems join the locomotives are exchanged. Illustrated notes are given on energy supply and line consumption. The article is to be concluded.—*Elek. u. Masch.* (Vienna), Nov. 15, 1914.

Installations, Systems and Appliances

Control of Motors.—A series of illustrated articles on motor control and regulation. E. A. Hanff deals with the magnetic switch, and A. G. Popcke outlines the various forms and classes of controllers used in industrial service, giving the relative advantages and disadvantages of each. Only fundamental standard forms are considered, as the design of special apparatus for specific requirement involves simply modifications or combinations of the fundamentals. J. H. Albrecht deals with furnace skip-hoist control, H. L. Beach gives an analysis of diagram construction, W. H. Patterson discusses automatic starters and controllers, A. G. Ahrens magnetic control for steel-mill auxiliary motors, H. D. James electric elevator control, W. O. Lum magnetic controllers for crane motors, W. E. Thau liquid rheostats for controlling wound-secondary induction motors, T. E. Simpers control of electrically driven rubber calenders, H. F. Boe the automatic control of laundry machines driven by alternating-current reversing motors, J. A. Blickman the manufacture of electric controllers, T. S. Perkins the evolution of industrial controllers, R. L. Kimber control panels for synchronous motors, Graham Bright control for mine hoists, W. Sykes and G. E. Stoltz the control of induction motors for rolling-mill drive, H. C. Nagel the design and application of rheostats, W. R. Johnston the selection of control apparatus for portable drilling rigs.—*Elec. Journal,* December, 1914.

Wires, Wiring and Circuits

Heating of Conductors.—T. HIROBE.—An abstract of a report on a theoretical and experimental investigation of the heating and insulation deterioration of current-carrying conductors. The results are summarized under the following headings: insulating materials investigated, methods of measurements, specific resistance of copper, specific conductivity and emissivity, insulation resistance, dielectric strength, specific inductive capacity.—The original voluminous report was published as Report No. 12 of third section, Electrochemical Laboratory, Tokio, Japan. Abstracted in London *Elec. Review,* Nov. 6, 1914.

Electric Conductors.—TH. BAILLANT.—The author has worked out new tables for the rapid determination of the cross-section and of the voltage drop in electric lines, from the figure of the kilowatt multiplied by the length in meters for different voltages and power-factors.—*Elek. Zeit.,* Nov. 19, 1914.

Cable Laying.—BRUGSCH.—An illustrated article on the methods of laying the cables for energy supply to the elevated railroad in Hamburg.—*Elek. Zeit.,* Nov. 12, 1914.

Electrophysics and Magnetism

Contact Rectification.—RALPH C. HARTSOUGH.—Much experimental evidence has been brought to light upon the phenomenon that a large current will pass in one direction and that only a small current, if any at all, will pass in the opposite direction through contacts of certain dissimilar solids. But some important points have remained undecided. The author has made a careful investigation with a silicon-carbon contact. The surfacing and finishing as well as a suitable mounting of the silicon received much attention. Two points applied gave approximately twice the magnitude of rectified current that one point gave. Also, two pairs of surface areas, surfaced exactly the same way, one area being a little over twice that of the other, gave very nearly twice the rectified current. The author concludes that the magnitude of the rectified current is approximately proportional to the area of contact. The surfaces were photographed and some interesting conclusions reached. There is a "forming" action of the surfaces. By "forming" is meant that a better rectifying surface results from certain manipulation. The "forming effect" is a bringing of more points on the surface into activity. Pressure would bring more points into contact, theoretically, but increased pressure does not increase the rectifying properties of a surface. Pressure evidently has a crushing effect on the points of the surface, thereby destroying the property of rectification. The author's theory is that in the "forming processes" there are points which are very close yet not active as rectifiers and an increase in voltage causes an arc across these points, bringing them into contact. This theory is compatible with the fact that two surfaces which have been "formed" when separated have to be "re-formed." This shows that there is no chemical formation and that

this forming is evidently a point phenomenon. A surface once "formed" will hold constant as a rectifier as long as it is undisturbed. A novel effect was discovered, namely, that a rectifier which would give complete rectification with an alternating emf would allow with equivalent value of direct emf as much as 15 per cent to 20 per cent of the current to pass in the high-resisting direction. Data are given on the relation between current and pressure.—*Phys. Rev.*, October, 1914.

Units, Measurements and Instruments

Meter.—An official communication by the Reichsanstalt by which modifications of a magnetic motor meter for direct current made by the Allgemeine Elektricitäts Gesellschaft and an alternating-current induction meter of the same company are admitted for calibration. —*Elek. Zeit.*, Nov. 12, 1914.

Telegraphy, Telephony and Signals

Wireless Telegraphy in Australia.—J. G. BALSILLIE. —A paper illustrated by diagrams presented before the British Association on wireless telegraphy in Australia. It was considered that for the purpose of efficiency and economic control all stations should be of a standard design and range. A standard station was designed and stations of this type were erected at Melbourne and Hobart. Experiments with these stations were conducted with the object of ascertaining their mean average range with vessels at sea under varying conditions. The data collected from these experiments indicated that with average atmospheric conditions it was possible for Melbourne and Hobart stations to communicate reliably 450 miles to vessels at sea in daytime and approximately 1500 miles at night, provided that land intervened for not more than 5 per cent of the distance. It was ascertained that with land intervening the sea range of stations was reduced in the relation of five to two in respect of that portion of the distance which was over land. These particulars hold good only in respect to a 500 meter-wave length and day range. It was, therefore, decided to adopt as a standard within the Commonwealth stations a day range of 450 miles over sea, and nineteen of these stations have been erected. From experiments it was ascertained that aerials of the squirrel-cage type gave the most satisfactory results, and that using masts 160 ft. high an aerial capacity of not less than 0.0013 mf, and not more than 0.002 mf, should be used, when employing a 600-m wave, to obtain the best results. Practically all radiotelegraph stations intercommunicate at night, and even in the daytime adjacent stations intercommunicate. Melbourne signals are nightly heard at Perth, a distance of 1700 miles. Curves are given showing the difference in communication between different stations under atmospheric conditions in spring, summer, autumn and winter. Miscellaneous observations are added on the variation of the intensity of signals, the effect of wind on the strength of signals, the potential gradient and atmospheric disturbances, the direction of reception, the effect of fog and other disturbances.—London *Electrician*, Nov. 13, 1914.

The Arc as a Generotor of High-Frequency Oscillations.—F. MERCER.—A paper illustrated by diagrams presented before the Physical Society in London. This paper contains the results of a series of experiments on a copper-carbon arc when used as a generator of high-frequency oscillations. The author investigated the effect of the ratio of self-induction to capacity and the gas pressure on the production of oscillations. There is a definite value of inductance for any chosen capacity which gives a maximum current in the shunt circuit. The effect of increasing the gas pressure becomes more marked as the electrical pressure is increased, but as the gas pressure rises the steadiness of the arc diminishes. The effect is somewhat similar to that obtained by increasing the arc length. Any effort made to increase the output by the use of a magnetic field or by altering the arc length or the resistance in series with the arc is detrimental to the steadiness of operation.—London *Electrician*, Nov. 20, 1914.

Cable Telegraphy.—H. W. MALCOLM.—A continuation of his long mathematical series on future progress of cable telegraphy. The author discusses trains of damp oscillations and the influence of signaling condensers.—London *Electrician*, Nov. 20, 1914.

Miscellaneous

"Point Five" Association.—PICKVANCE.—His address as chairman of the "Point Five" Association. The association has for its object a very definite self-centered scheme, namely, the encouragement and development of the use of electricity for all possible domestic purposes. The author urges that just as the motor load has been built up by the central stations availing themselves of their power of hiring motors, so this association should use all its endeavors and energies to draw into its ranks all those engineers who are in a position to hire cookers and heaters, "so that the ultimate results will be such as to secure for us the hearty co-operation of manufacturers, by reason of the fact that we, collectively, shall be able to place orders in quantities much greater than is possible at the present time. The absence of powers to wire houses, supply or hire cookers and heaters is so important to the object to which this association is pledged that we cannot get away from it." The author then takes up the competititon with gas companies and the question of mains. An account of the extended discussion which followed is also given.—London *Electrician*, Nov. 13, 1914.

Book Review

ELECTRIC-LIGHT ACCOUNTS AND THEIR SIGNIFICANCE. By H. M. Edwards. New York: McGraw-Hill Book Company, Inc. 172 pages, illus. Price, $2.

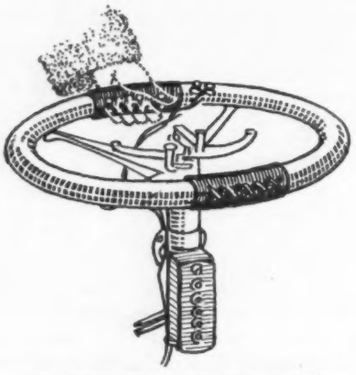
With the amount of attention that is being given to the matter of standard accounting systems for public utilities by the engineering organizations as well as by the various regulating bodies, it is not surprising that more books on accounting subjects are becoming available. "Electric Light Accounts" is prepared by an authority on accounts for electric-lighting utilities and contains a clear and concise statement of the object of accounting systems in general and an outline of a system which is especially adapted to electric-light companies. A mere statement of the division or classification of accounts would prove of little value, but the explanations accompanying the statement of the various accounts to be carried make the book a useful one to central-station managers and accountants. The text is divided into three parts: Part I, "Balance Sheet"; Part II, "Income Accounts," and Part III, "Miscellaneous Items." Chapters under these parts deal successively with description of balance sheet, plant investment, current assets, suspense accounts, liabilities, reserves, capital stock, definition of income, gross earnings from operation, operating expense accounts, account symbols, work order system, customers' accounts and records, accounting for supplies, renewal and contingency reserves, the income statement and what it should contain, and analysis of a balance sheet. Specimen forms for various accounts are given, and a complete index makes the volume available for ready reference.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Electrically Heated Grip for Steering Wheel

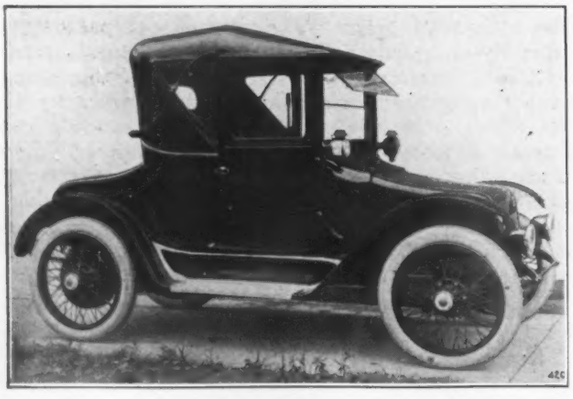
Electrically heated leather-covered grips for use on steering wheels of automobiles have been developed by the Interstate Electric Company, New Orleans, La. The grips are attached to the wheel, as shown in the accompanying illustration, and are provided with laces for making them tight. Energy may be obtained from the storage battery of the car or, if the magneto's rating is high enough, from the magneto.



ELECTRICALLY HEATED GRIPS

Three-Passenger Electric Cabriolet

The cabriolet shown herewith is designed chiefly for business men and is equipped with a convertible body. All panels and battery hoods are of sheet aluminum and the top is of leather. An auxiliary front seat is provided for a third passenger. The width of the rear seat is 50 in. and the depth is 18 in. The car is 7 ft. 4 in. high, 5 ft. 7 in. wide and 11 ft. 10 in. long. A forty-two-cell battery is used to operate the car. The steering lever and the controlling lever are mounted on the side of the car in a horizontal position, one above the other. The steering lever is the longer and is operated by the right hand, while the controlling lever is operated by the left hand. When the driver leaves the car these levers may be turned up out of the way and locked. Three separate sets of brakes are provided, and they operate independently. Use is made of two sets of foot brakes of the internal-expanding type. An electric hand brake which is also used is applied by a slight backward movement of the controller lever. The wheel base of the car is 100 in. The car can be operated at speeds of 5, 8, 13, 17 and 20 miles per hour. The car is being built by the Anderson Electric Car Company, Detroit, Mich.



ELECTRIC CABRIOLET

Refillable Cartridge Fuses

A refillable fuse of the cartridge type recently developed by the Star Fuse Company, 448 Broome Street, New York, has been approved by the National Board of Fire Underwriters and the New York City Department of Water Supply, Gas and Electricity. The device is a standard cartridge fuse, being approved as such, and is said to be the first fuse of this type that has been passed by the above authorities. The fuse consists of an inner cartridge made up of a fuse wire which is wrapped in a filler of two sheets of asbestos and inclosed in a glass tube having brass end caps to which the fuse wire is soldered and which are cemented to the glass tube. A small space is maintained between the two sheets of asbestos to indicate the condition of the fuse strip. When the fuse blows this space becomes blackened. The complete fuse or inner cartridge is inclosed in a holder consisting of a fiber tube threaded at each end and threaded brass end caps which are equipped with inner spring clips to hold securely the inner cartridges and insure positive electrical contact. When the fuse blows it is necessary merely to replace that part which is actually destroyed, while the outer brass caps and fiber shell can be used over and over again.

FIG. 1—FERRULE TYPE OF REFILLABLE FUSE

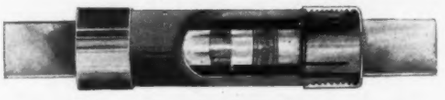
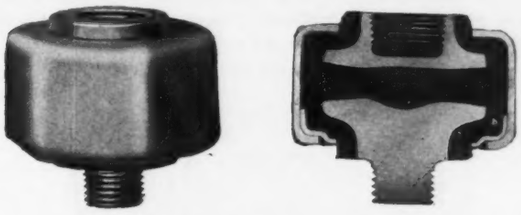


FIG. 2—KNIFE-BLADE FUSE

FIG. 3—RENEWABLE ELEMENT

Insulating Joints

An insulated joint provided with malleable-iron pipe connections and a drawn-steel shell is shown in the accompanying illustration. The insulating material used is called thermoplax, a compound developed by the Cutler-Hammer Manufacturing Company. The pipe connections are equipped with Briggs standard iron-



JOINT WITH FEMALE AND MALE CONNECTIONS

pipe threads. In making the joints the pipe connections are held in alignment and the supplemental or reinforcing shell kept in the die, while the insulating compound is compressed under a pressure of 35 tons. The interior of the shell is molded into one solid mass. The curing of the insulated compound is done at a temperature of 600 deg. Fahr., and each joint is tested at a pressure of 4000 volts, not only between the two pipe connections but between each pipe connection and the outer shell. Joints provided with female and male connections and female connections at both ends are being made. The joints are the product of the Yost Electric Manufacturing Company, Toledo, Ohio.

A Mechanical Rectifier for Heavy Currents

A mechanical rectifier comprising a pole-changing commutator driven by a specially designed synchronous motor has been devised by Mr. Henry Sandell, Chicago, who is also the inventor of the remarkable electrical violin player which is described elsewhere in these columns. The new rectifier is apparently capable of handling large currents without sparking or heating, and it operates at very high efficiency since the only losses are those of the small motor necessary to drive the commutating switch against the friction of the brushes. The device has applications for charging storage batteries, furnishing direct current for arc-lamp projector lanterns, etc. Several 100-amp machines have been built and are in operation; a 400-amp equipment has been in service at Adams Brothers' Garage, 918 East Forty-third Street, Chicago, for two months, being used to charge electric vehicles, and a 1000-amp machine is now built and awaiting accessory apparatus. Furthermore, it is stated that the Chicago surface-railway company is interesting itself in the prospective purchase of two 8000-amp rectifiers to furnish trolley energy.

The synchronous motor used to drive the commutating element is, according to the inventor, arranged with special interpoles and compensating windings effecting such control of its speed and phase relations that the point of reversal between commutator segments is always maintained precisely at the instant of zero voltage. The synchronous motor is also self-starting, closure of a switch sufficing to put the machine into operation. For battery-charging service only that part of the alternating-current wave above battery voltage is utilized, the special commutator segments being of such reduced length that the current flow is interrupted at the exact instant when the delivered pressure equals the battery emf. This remarkable regulation is said to be effected through means of a small auxiliary brush bearing on the commutator just ahead of one of the main brushes. Protective devices are incorporated in the control equipment to interrupt the circuit in the event of disarrangement of the governing mechanism.

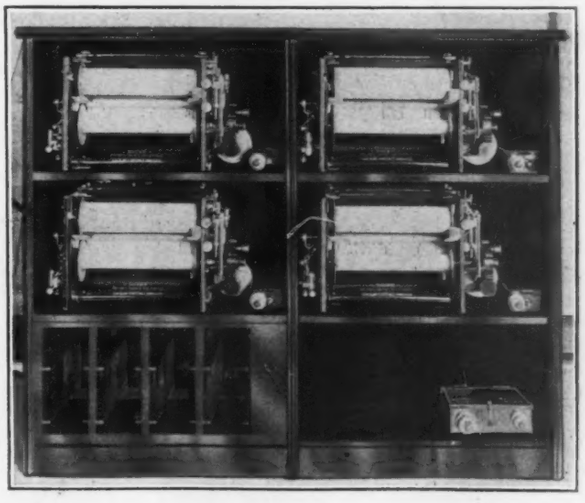
The inventor is now building a three-phase rectifier, similar in principle to the single-phase apparatus described, and from which it is declared practically constant direct-current emf will be delivered, the change in commutator segments being made at the instant of voltage balance between successive phases.

In the case of a 100-amp rectifier operated in the workshop of the manufacturer, the Mills Novelty Company, Jackson Boulevard and Green Street, Chicago, the direct-current arc-lamp load on the machine was varied rapidly from 30 amp to a 70-amp short-circuit without affecting the regulation of the rectifier or causing sparking. When running idle a slight inductive spark or arc was in evidence at the brushes, but this practically disappeared when the load was thrown on. One of these small rectifiers is now being adapted for mounting on the body of an electric passenger car so that the car can be charged from any alternating-current source of the proper frequency. The 100-amp switch weighs complete with motor and mechanism about 45 lb., and a 40-amp machine suitable for vehicle charging will weigh proportionately less.

Remotely Controlled Electric Violin Music

The remarkable electric violin player already described in these columns has been used to advantage to furnish the music for moving-picture theaters, thus dispensing with the services of musicians and others in the front of the theater. The electric violin player, with its accompanying piano, is operated by a punched paper roll, through the perforations of which electric contact brushes complete circuits controlling the "fingering" at the frets, the speed and pressure of the revolving "bows," and various other expression adjustments which make the performance of the electrical violin player approach that of the human performer.

For the use of moving-picture theaters where a



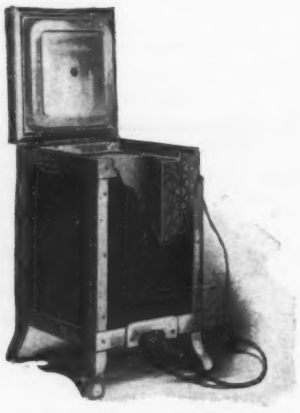
MULTIPLE-CONTROL APPARATUS FOR ELECTRIC VIOLIN PLAYER

single attendant collects tickets and supervises the interior of the auditorium, the Mills Novelty Company, Jackson Boulevard and Green Street, Chicago, has brought out a "four-feeder" roll attachment, by which any one of four different pieces of music can be switched onto the violin player at will from a face-plate switch

near the ticket taker's station. With this device appropriate music can be rendered for each film presented, any one of the various music rolls being instantly substituted for another by a change of the switch arm. The accompanying illustration shows the four sets of contact devices, any one of which can be switched onto the player circuits.

Electric Cooker

The heating element of the electric cooker shown in the accompanying illustration is placed below a cast-iron bottom and is thus protected from injury. The device is lined with aluminum and is insulated with rock wool. The outer case is enameled in blue-black



ALUMINUM-LINED ELECTRIC COOKER

and is equipped with polished-steel trimmings. The lid closes in a "water seal" V-shaped groove and is provided with an exhaust valve which is useful when the cooker is employed as a baker. The device is mounted on ball-bearing casters and may be equipped with an automatic clock regulator if desired.

This cooker is being manufactured by the Standard Electric Stove Company, Toledo, Ohio.

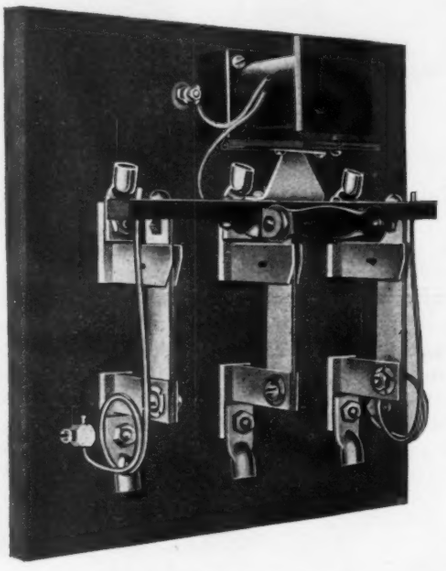
Vertical Motor-Generator for Motion Pictures

The machine shown in the accompanying illustration is designed to convert alternating-current energy into direct-current energy for operating the arc lamp of a motion-picture set. The apparatus has been made very compact so as to take up the smallest possible space in the operator's booth. The control and indicating devices are placed on a switchboard above the rectifier. The regulator, it is claimed, will instantly adapt the arc to the correct intensity for a film of any character. The switches shown in the illustration control the starting of the rectifying device and the delivery of direct-current energy to the arc lamp. The machine takes up a space 15 in. square, and it is 29 in. high when rated at 50 amp and 34 in, when it is rated at 70 amp.

The device described here is manufactured by the Electric Products Company, Cleveland, Ohio.

Remote-Control Service Switch

A switch permitting the opening of the circuit at the service entrance of buildings from a convenient point is shown in the accompanying illustration. The switch is installed where the service wires enter the building, and control wires lead from it to a push-button near the main entrance. The main switch is operated by springs and held closed by a latch controlled by a coil made up of two windings so arranged that if one of the fuses should be out current from the other side would



SERIES SWITCH CONTROLLED BY PUSH-BUTTON SWITCH

serve to energize the control coil and release the switch. The switch is made in the unfused and top-and-bottom-fused types and may be back-connected or front-connected as desired. It is being placed on the market by the A. G. Electric & Manufacturing Company, 905 South Howard Avenue, Seattle, Wash.

Collapsible Portable Lamp Holder for Travelers

The portable lamp holder illustrated herewith can be supported in a number of positions and can be converted into a compact, unbreakable form for carrying in a traveling bag. It consists of three separable parts

FIG. 1—ENTIRE UNIT REASSEMBLED FOR SUITCASE

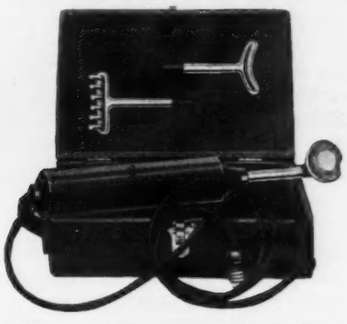
FIG. 2—PORTABLE LAMP

—the base, socket and connector cord, and shade. Concealed in the base is a spiral-spring clamp and a rubber cup which are employed to fasten the lamp holder to any mirror, desk, chair, bed, etc. Passing through the base and attached to the cup is a rod with a hinged top

on which the lamp socket can be fastened. The shade is equipped with two spring-steel wire loops which clasp the lamp bulb, allowing the reflector to be turned in any direction. The socket is provided with a 10-ft. connector cord and screw plug. To prepare the device for carrying in a suitcase or traveling bag, the socket is removed from its support by a half turn and the plug screwed into it. The combined plug and socket are then placed between the shade clasps, the connector coil is coiled around them, and the base and shade are clamped together. Assembled in this manner, the device occupies very little space and weighs about 1 lb. No lamp need be carried with the device as one can usually be found in the socket to which the lamp holder is attached. The device is manufactured by the Wallace Novelty Company, 18 East Forty-first Street, New York City.

High-Frequency Generator

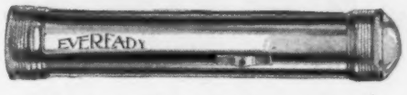
For treating various diseases, invigorating the nervous system and facilitating the performance of physiological functions a small machine generating energy at high frequencies has recently been developed by the Bleadon-Dunn Company, 208 North Fifth Avenue, Chicago, Ill. This "Violetta" generator, as it is called, weighs only 1.5 lb. and operates on both alternating current and direct current. A vibrating spring gives a low hum and the character of the sound denotes the quality of the interruption. The energy is produced at a pressure of about 75,000 volts, and the current is a small fraction of 1 amp. Oscillations of several millions per second are produced and the frequency is so high that there can be no shock. The apparatus is inclosed in a small case, as shown in the accompanying illustration, and is provided with various types of electrodes for treating the scalp, face, throat, etc.



SMALL HIGH-FREQUENCY SET

Tubular Flashlamp

A tubular flashlamp equipped with a brass case which is heavily nickeled has recently been developed by the American Ever Ready Works, 304 Hudson Street, New York. The case is made in the following sizes: 1.25 in. by 5 in., 1.5 in. by 6.5 in., and 1.5 in. by 8.5 in. A 2.7-volt tungsten lamp is used with the first device, a 2.9-volt lamp with the second, and a 3.8-volt lamp with the third. Large lamp reflectors are used with the two larger sizes. Both battery and lamp are renewable.



NICKEL-PLATED TUBULAR FLASHLAMP

Battery-Operated House Lamp

A small electric lamp inclosed in a nickeled-metal case is shown in the accompanying illustration. The device is designed especially for use by the housewife in the home. A tungsten lamp equipped with a silver-plated parabolic reflector is used. Two sizes of this lamp are being made, one having dimensions of 4.75 in. by 4.5 in. by 3.5 in., and the other of 4 in. by 2.75 in. by 2.5 in. Both the lamp and the battery are renewable. The American Ever Ready Works, New York, make this lamp.

HOUSE LAMP

Electric Washer Equipped with Aluminum "Vacuum" Cups

An electric washing machine equipped with two aluminum cups, which work up and down alternately while the tub rotates, is being placed on the market by the Beebe Sales Company, Minneapolis, Minn. The frame is of steel, and the tub and cover of galvanized open-hearth steel. The machine will wash five sheets, it is declared, or the equivalent, at one time. One lever controls the clutch, which throws the vacuum cups into action, and another, operating independently, controls the wringer. The wringer swings into three positions and can be used with stationary tubs. The wringer is reversible and is equipped with a tilting water board. When the washing is finished the water can be drawn from the bottom of the tub. The machine is on rollers, so that it is not difficult to move it about if desired.

ELECTRIC WASHING MACHINE

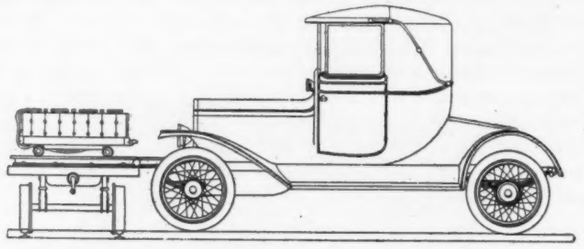
Electric Mine Lamp

A lamp which is designed for use in mines and which can be attached to the operator's cap is being placed on the market by the Witherbee Igniter Company, Springfield, Mass. A wet cell inclosed in a cast-aluminum case is used to operate the lamp. The case is attached to a belt strap at the miner's waist and is locked. An insulated twin-conductor wire leads up along the wearer's back and over the cap to a reflector lamp attached to the oil-torch support on the cap visor. A tungsten lamp is used, and it is equipped with a German silver parabolic reflector. In order to remove the possibility of an explosion of gas due to the exposure of the glowing metallic filament in case the lamp bulb is broken a device is provided which opens the circuit as soon as the bulb is shattered. This device consists of a wire wicket which holds the bulb in position against two spring-pressed plunger connections which are of unequal length. In case the glass is broken the longest plunger pushes the bulb case out of contact with the shorter one. The lamp socket is a one-piece drawn-steel tube. The face of the reflector and bulb are protected by heavy plate glass, held in position by an expanding spring forming a dirt-proof and moisture-proof joint at the reflector. To the back of the reflector housing is affixed a brass-wire hairpin for carrying the lamp on an oil-torch support provided on the cap visor.

ELECTRIC MINER'S LAMP

Interchangeable-Battery System for Electric Vehicles

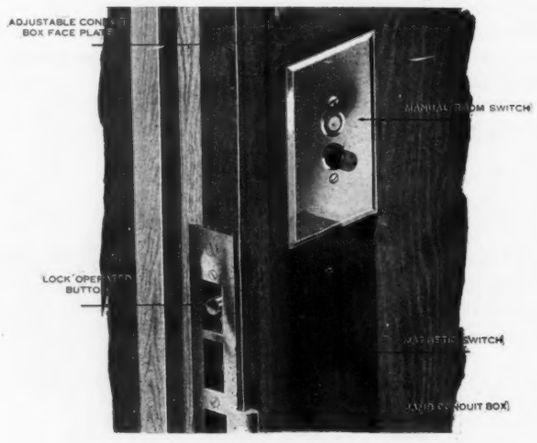
Convenient means of quickly placing charged storage batteries in electric vehicles and removing the discharged cells for replenishment at an economical low rate, while the cars themselves are meanwhile kept in active service, are provided in the multi-battery system for garages and charging stations which is being introduced by the Klingelsmith Electric Truck Company, 79 West Monroe Street, Chicago. With this system the batteries are mounted permanently in small cars or carriers with ball-bearing flanged wheels which rest on small rails in the battery compartments of the vehicles. On reaching the station the discharged battery is run out of the vehicle compartment onto a platform or a small transfer car moving over a floor track leading to the battery-charging platforms. After the spent cells are removed a freshly charged battery can be immediately run into the vehicle and the latter immediately released for further service on the road. The vehicles are thus kept in continuous service if desired, and are always assured a fresh set of cells upon return to the station. As the batteries can be charged at an economical and low rate, subject to the inspection of the attendant, it is estimated that great saving in the life of the cells will be effected. The injurious effects of rapid "boosting" are avoided, and the cells are insured proper attention, washing of plates, changes of electrolytes, flushing of jars, etc. With an equipment of different kinds of cells, the appropriate battery can also be selected for the work which the truck or vehicle is to perform on any given trip. The battery carriers have been designed to be interchangeable and to fit all types and sizes of electric vehicles. It is proposed that the service stations shall own the batteries, thus relieving the owner of the car or truck of the investment in batteries and their care and maintenance, although securing for him unlimited mileage and service at less, it is declared, than half the present cost. The multi-battery system described is protected by patents issued to Mr. Joseph M. Klingelsmith, of the company.



BATTERY BEING DELIVERED TO VEHICLE FROM TRANSFER CAR

Hotel Door Switch

A solenoid-operated switch designed for use in hotel rooms for opening the lighting circuit after the guest has left his room has been developed by the Hart Manufacturing Company, Hartford, Conn. The switch is installed in the jamb of the corridor door back of the lock strike and is wired in series with a push-button switch. The jamb switch is operated by the bolt in the door lock, which is used when locking the door, from the corridor side. When the door is locked from the room side, however, the switch is not operated, as a separate bolt is used. When the door is locked from the corridor side the switch opens and all lamps are extinguished, but unlocking the door immediately places them in circuit. The lamps are always under the control of the occupant of the room when the door is not locked from the corridor side. These switches cannot be used with the ordinary flat strike but must be installed with box-type strikes. The accompanying illustration shows how the push-button room switch may be installed in a special jamb conduit box.



DOOR SWITCH FOR USE IN HOTELS

Jobber, Dealer and Contractor

NEW YEAR WINDOW DISPLAY

Seasonable Setting for the Beginning of the Year—Need of Attractive Store Fronts as Business Getters

BY A. J. EDGELL*

Reports from all parts of the country indicate greatly increased sales of electric appliances for Christmas gifts. The national advertising of the manufacturers and the efforts of the retailers have made this "an electrical Christmas" to a much greater degree than ever before.

Frequently the effort put forth to increase Christmas business is followed by a reaction which allows an opportunity to slip away. To be sure, there is not much business to be had on the day after Christmas, but in the succeeding days the economically inclined do their shopping. They have waited until after Christmas to

SUGGESTION FOR NEW YEAR'S WINDOW DISPLAY

supply their wants. To prepare for these shoppers the dealer should rearrange his windows. He should also play on the New Year spirit.

New Year's Day is the time for resolutions, the time when people "turn over new leaves" and face the coming year with higher purposes than at any other time. It is the time to urge them to "make 1915 an electrical year."

A display such as the sketch shows calls attention to some of the things that may be done electrically. A circular card, on which is painted "Old Father Time," and an hour glass with figures 1915 are fastened to the background. These may be obtained from a show-card maker, at little cost. Icicles cut from cardboard or cotton batting and sprinkled with diamond dust are also fastened across the background. Some of the appliances are elevated on pedestals which are draped with velours. Cards reading "Wash," "Light," "Heat," "Cook," "Iron," "Clean," are used on the various devices. The large card reads: "Make 1915 an electrical year and it will be a happy one."

Since this is the time when plans are made for the coming year, a good New Year resolution for an electrical dealer is, "I will try to get a proper share of the business that passes my doors each day." Not a very long one, but if carried out its effect on his business would be far-reaching. The dealer would take his proper place among merchants and could count on the profit made from transient trade to pay his overhead expenses.

The public demands an attractive and modern store front, and a dealer should have one in these days when successful competition is largely a matter of being right on details. So, in his endeavor to "make good" on his resolution, he should go out and size up his store front with the cold, calculating eye of the passer-by. He will probably be amazed at the ugliness of his store's appearance. What he does after his realization of the uninviting appearance of his store front will tell whether he is to get the results he might. If he immediately gets in touch with a painter and an electric-sign manufacturer, he has made a good start.

In the show window there is great room for improvement. To many dealers the possibilities of this publicity factor have not yet become apparent, so they continue to neglect a most wonderful opportunity to attract trade. The average window display has nothing about its make-up to secure more than a passing glance, and very often the impression received by the possible customer is not of the kind that will create a buying desire later. It is rather likely that the jumbled-up appearance of the display will convey the idea that business is being conducted in a loose manner.

A window in which a few goods are arranged in an artistic manner will create immediate sales or will develop interest that will lead to future sales. Windows suffer from over-crowding more than from the other extreme. The mission of the show window is to sell goods, and it is far better to sacrifice the picturesque effect than the selling punch.

A good background with a few articles that are novel or show their value and price tickets used wherever possible can be counted on to attract the attention of the passers-by. Many dealers' windows have no background, so the arrangement of goods, however attractive, cannot secure the whole attention of the passer. The view of the store interior distracts his attention. For this reason, if there were no others, a show window should have a background.

*The Society for Electrical Development, Inc.

Christmas Co-operation at Oklahoma City

The electrical supply dealers of Oklahoma City, Okla., began their holiday electrical appliance campaigns the first of December and in the first four days sold fifty irons and about one-third as many toasters. The local central-station organization, the Oklahoma Gas & Electric Company, of which Mr. W. R. Molinard is manager, co-operated in the dealers' campaigns by conducting a display of electrical appliances in connection with the National Manufacturing Exhibit, which was held in Oklahoma City during several weeks of December. Streamers of electric lamps installed along the streets, together with other measures of publicity, were used to call attention to the exhibit, which in turn advertised the contractors' campaign.

Working Together in New York

The United Electric Light & Power Company, New York City, is co-operating with one of the manufacturers of electric cooking utensils to stimulate the demand for its appliances. Folders describing and illustrating a vacuum cleaner, a toaster, a hot-plate and an iron are being sent to every person in the electric-service company's territory together with a list of special prices on these devices and a return post card by means of which interested persons can request a salesman to call and demonstrate the article marked thereon.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Glass Ash Tray.—The General Electric Company, Ltd., 67 Queen Victoria Street, London, England, is distributing an ash tray molded in its "Equiluxo" glassware. This class of glassware is being made in the form of bowls and globes for the lighting of showrooms of drapery establishments, department stores, etc.

Pittsburgh Company to Make "Una-Flow" Engines.—The Mesta Machine Company, of Pittsburgh, Pa., recently acquired the rights from the Stumpf Una-Flow Engine Company, of Syracuse, N. Y., to build the Stumpf "Una-Flow" engines in the United States. The Mesta Machine Company is working on plans to adapt this type of engine for use in rolling mills and also to drive electric generators, air compressors, hoisting engines, etc.

Wide Use for Resuscitating Apparatus.—The Life Saving Devices Company, 565 Washington Boulevard, Chicago, Ill., reports that its "lungmotor" is being used by the United States government in a number of its departments, by several states and by many cities. The apparatus is also employed in many hospitals and sanitariums. Among the central-station companies, the Illinois Traction Company, Peoria, Ill., has fourteen sets, and the Southern California Edison Company, Los Angeles, Cal., twenty-four sets.

Long-Distance Recording Instruments.—Although the long-distance recording system described in the *Electrical World* of Dec. 12, 1914, page 1165, has only recently been placed on the market, several trial installations have been in operation for some time. One of the first outfits was installed at Peoria, Ill., for the Central Illinois Lighting Company to indicate at the central station the steam pressure at the end of a steam-heating main. Since the installation of the first outfit two other sets have been added.

Complimentary Tickets for Showroom Display.—The Kandem Electric Company is sending out so-called complimentary tickets for admission to its showroom at 49 East Twenty-first Street, New York, where it is exhibiting various types of incandescent lamps and arc lamps and accessories. Each ticket bears the caption "Admit one and friends." "Good until Jan. 30, 1915," is also printed on the ticket. The Kandem company's factories are in Germany, and it has recently been receiving shipments via both Holland and Italy.

Electrical House-Goods Business Improving.—Edwards & Company, 140th and Exterior Streets, New York, report that the house-goods business is showing a decided upward tendency, and that conditions will soon be normal. This company has recently developed a fire-alarm box of the break-glass type which is being employed extensively in New York City. The company is also meeting with considerable success with its riot bells designed for use on motor-driven fire apparatus. Several other types of electric bells and a push-button call system have been marketed.

Storm Ravages Telephone Line.—On Dec. 7 and Dec. 8 over 25,000 miles of wire and 1200 poles of the toll and local lines of the Southern New England Telephone Company were blown down as the result of a severe storm. Emergency shipments of material for making temporary repairs were made from the Western Electric Company's warehouse at West Haven, Conn., and toll lines to every exchange in the State were placed in service again by the evening of Dec. 10. In the seventy-two hours that elapsed between 7 o'clock p. m. Dec. 7 and the same time Dec. 10 1,000,000 ft. of twisted-pair copper-steel distributing wire, 93,000 lb. of bare copper wire, 19,000 lb. of iron wire, more than a ton of copper tie wire and 26,000 sleeves were shipped by the Western Electric Company. Shipments were made by means of special trolley cars and three freight cars. Numerous shipments by express were also made.

Storage Battery Plant Not Damaged by Edison Fire.—The fire that destroyed part of the Edison Phonograph Works at Orange, N. J., did not affect the plant of the Edison Storage Battery Company, which is across the street from Mr. Edison's private laboratory. The telephone exchange was in one of the burned buildings, but owing to the prompt action of the New York Telephone Company a temporary switchboard was installed in the battery company's office before business hours the day after the fire began. The Public Service Electric Company also put emergency lines in service in a very short time, so that the Edison Storage Battery Company suffered no interruption in its operation, despite the extensive nature of the fire.

Preparing for Fan-Selling Campaign.—The Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York, are preparing to start on an active campaign, the first of the year, to sell electric fans for the coming season. A bulletin describing the various types of fans which the company is making will be issued in the near future. At this time, of course, the fan business is rather quiet, although it is expected to pick up very quickly with the beginning of the new year. Several new fittings and conduit boxes have recently been developed by the Sprague Electric Works. The policy of this concern lately, however, is to make fewer special fittings and to devote its attention more to the development of standard devices. The business of the Sprague works has recently been rather dull, and this is said to be due to the industrial depression everywhere.

Equipment for Indianapolis Street Lighting.—The Merchants' Heat & Light Company, Indianapolis, Ind., which has recently been awarded a ten-year contract for street lighting in Indianapolis, has just closed a contract with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for 2680 street lamps and the necessary regulating devices and switchboards. The lamps are of the flaming-arc type, and each has a rating of 1400 cp. The new contract with the city goes into effect April 1, 1915. The installing of the lamps will begin immediately on their arrival, and, it is declared, they will be set up and connected before April 1. The company now awaits a decision from the Public Service Commission on a requested bond issue, totaling approximately $500,000, to be used in defraying the expenses of new equipment that will be required for carrying out the contract.

Order for Traction Equipment.—The St. Louis Car Company, St. Louis, Mo., and the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., have been awarded a contract by the City Railways of Los Angeles for equipment to be placed on exhibition at the Panama-Pacific Exposition which later will go into city service. The apparatus consists of a car of low-floor design which is equipped with double Westinghouse No. 306 50-hp motors and lightweight type "HL" pneumatic control. The Cushing Traction Company, of Cushing, Okla., has just placed an order with the Westinghouse company for a 500-kw geared generator and turbine, one 50-ton locomotive, and equipment for two passenger cars for its new 1500-volt line. This line runs from Cushing to Drumwright, Okla., and will be primarily a freight road, taking most of its traffic from the oil fields. The Manhattan Bridge Three-Cent Line, New York, has recently placed in service six new low-floor cars equipped with four Westinghouse No. 323-A motors and lightweight type "HL" control apparatus. This order is in addition to equipment for four cars purchased in the spring of 1913 from the Westinghouse company. The Easton Transit Company, Easton, Pa., has also just purchased one four-motor equipment of No. 306 Westinghouse motors and type "HL" control.

Engine-Stopping Devices.—Owing to the general movement for greater safety in industrial plants the Consolidated Engine-Stop Company, New York, is noting an ever-increasing demand for its electrically operated engine-stop and speed-limiting devices. Legislative enactments for the betterment of employees in factories and power plants have aided considerably in bringing about this demand. Over 5000 installations of the above company's engine stops have been made, among which are those for the following concerns: B. B. & R. Knight, Providence, R. I.; the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; the La Belle Iron Works, Steubenville, Ohio; the Hotel Astor, New York; the Yale & Towne Manufacturing Company, Stamford, Conn.; the Eastman Kodak Company, Rochester, N. Y.; the Link-Belt Engineering Company, Philadelphia; the Hotel Belmont, New York; the Winton Motor Carriage Company, Cleveland, Ohio; the Brown & Sharpe Manufacturing Company, Providence, R. I., and the B. F. Goodrich Company, Akron, Ohio.

Professor Crocker on the Industrial Situation.—Prof. F. B. Crocker, of the Crocker-Wheeler Company, Ampere, N. J., recently stated to a representative of the *Electrical World* that his company has been affected by the general depression that is taking place throughout the country, and, although there has been no material improvement, judging from inquiries being received and the gradual easing up of industrial conditions, a resumption of business activity is expected very soon. In fact, Professor Crocker declared, his company is preparing for a marked change for the better after the first of the year. The Crocker-Wheeler Company is largely a manufacturer of motors and generators, and it has been found that when business is slack companies will repair and patch up old units rather than buy new ones. Again, on account of the flexibility of motor drive and the ease with which motors can be moved from place to place, there is a tendency in factories where all the machines are not working to strip one machine of its motor and substitute it for another which may have broken down. Professor Crocker remarked that his company is not making a strenuous effort to obtain foreign business; however, foreign orders are frequently received. Many of these orders come through commission merchants in New York City. The Crocker-Wheeler Company, on account of its proximity to New York and its ability to transfer its products from the factory to steamers by means of trucks, Professor Crocker stated, is able to handle foreign business very satisfactorily. On account of the war and the elimination of much of the European competition, the foreign business of the company, he asserted, should increase very much.

Compensator Contract Awarded in Chicago.—The Lincoln Park Commissioners, under whose jurisdiction most of Chicago's North Side boulevards are administered, has awarded a contract for 800 compensator coils to be used with gas-filled tungsten lamps, the order being divided equally between the General Electric Company and the Westinghouse Electric & Manufacturing Company. Before a selection was made the sample compensators submitted by five different manufacturers were tested in the electrical laboratories of Lewis Institute and of Armour Institute of Technology to determine from an engineering standpoint the relative mechanical and electrical characteristics of the compensator coils. As first choice one of the schools chose the sample of one of the successful bidders and the other school chose the sample of the other successful bidder. In awarding the contract, however, the commissioners pointed out the fact that the existing contracts for gas-filled lamps had been divided between the Westinghouse and the General Electric companies, and by dividing the compensator contracts, it was declared, the manufacturers could be held more closely to the terms of the contracts if failures occurred on units wholly of the same manufacture. In making the selection the question of price did not enter. Quality from an engineering standpoint was considered paramount. The lamps to be installed with the compensators are rated at 200 watts, the efficiency of the compensators is 92 per cent and the compensator coils are rated at 239 watts. The new equipment is to be installed to replace arc lamps now in service, and the work of reconstruction will be carried on under the direction of Mr. Claude H. Shepherd, engineer for the Lincoln Park Commissioners.

Corporate and Financial

Western States Gas & Electric Company to Renew Notes.—The California Railroad Commission has authorized the Western States Gas & Electric Company to renew $45,000 of promissory notes now held by H. M. Byllesby & Company.

California Company to Redeem Notes.—The Coast Valleys Gas & Electric Company has been authorized to issue $100,000 of first mortgage 6 per cent forty-year bonds at not less than 90. It is the purpose to use $65,392 to pay off notes payable and certain accounts, and to apply the balance upon additions and betterments.

Auglaize Power Company to Pledge Notes.—The Ohio Public Utilities Commission has authorized the Auglaize Power Company to pledge or hypothecate for a loan at not less than 80 $188,000 of its 6 per cent five-year collateral trust notes. The commission had previously authorized the company to dispose of the above notes at not less than 90, but owing to the stringency of money and the condition of the market the company did not succeed in disposing of them.

Sierra & San Francisco Protective Agreement.—Holders of the second mortgage 5 per cent forty-year gold bonds, series B, of the Sierra & San Francisco Power Company have been asked by the protective committee to deposit bonds with the Columbia Trust Company, New York. The amount of outstanding bonds aggregates $7,667,024. The protective committee is composed of Messrs. Philip L. Saltonstall, Francis R. Hart, Samuel R. Smith and Charles F. Mathewson.

Annual Report of Massachusetts Lighting Companies.—The annual report for the year ended June 30, 1914, shows consolidated gross earnings of $1,395,188, from which was deducted $982,496 for operating expenses, including taxes, leaving net earnings of $416,692. Deduction of interest charges of $119,593 and dividends of $269,565 left a balance of $27,534. Since 1910 the gas customers increased from 17,423 to 23,463, and electric customers from 4577 to 7100, the total connected load having increased from 7818 kw to 12,300 kw.

International Steam Pump Deposits.—The protective committee of the International Steam Pump Company, composed of Messrs. Lewis L. Clarke, Willard V. King and L. T. Haggin, of New York; Albert N. Parlin, of Boston, and Otto Marx, of Birmingham, Ala., announce that a considerable majority of the preferred stock and a large amount of the common stock has been deposited under the terms of the protective agreement. The time for depositing stock expired on Nov. 30, but the committee has extended it to Jan. 15, 1915.

New Maine Company Formed.—The Androscoggin Electric Company has been incorporated with an authorized capital stock of $2,000,000, of which $1,400,000 is common and the remainder 6 per cent cumulative preferred. It has taken over the Lewiston & Auburn Electric Light Company of Lewiston, Me., and the Portland & Lewiston Interurban Company. The transaction involves also the ownership of the Mechanic Falls Electric Light Company. The company will do without competition the entire electric-lighting and motor-service business in Lewiston, Auburn, Mechanic Falls and adjoining towns, representing a total population of about 50,000. The consolidated company owns a large hydroelectric station at Deer's Rips and is now building a steam station for emergency purposes. The company has filed a mortgage with the Union Safe Deposit & Trust Company of Portland, Me., as trustee, to secure $5,000,000 of first and refunding mortgage 5 per cent bonds, the present issue to be $1,800,000, dated Oct. 26, 1914, and due Oct. 1, 1934. Of the new bonds $1,200,000 are reserved to retire $1,200,000 first mortgage 5 per cent bonds of the Lewiston & Auburn Electric Light Company due June 1, 1939, and further bonds are reserved for 80 per cent of the cost of future extensions. Mr. William T. Cobb, Rockford, Me., is president and Mr. Julius Parkhurst, Lewiston, Me., is secretary-treasurer. The directorate is composed of Messrs. William T. Cobb, Maynard S. Bird, Hugh J. Chisholm, Harold Libby and Alla A. Libby.

California Railway & Power Company's First Annual Report.—The California Railway & Power Company has made its first annual report, covering the period Dec. 18, 1912, to June 30, 1914. The company controls the United Railroads of San Francisco, Sierra & San Francisco Power Company and Coast Valleys Gas & Electric Company, and is itself controlled by the United Railways Investment Company. The earnings statement for the above period is as follows:

Income:		
Dividends on stocks owned	$605,000	
Interest on notes and accounts receivable, etc.	220,419	
Interest on bank balances	4,482	
Total		$829,901
Expenses:		
Salaries	$2,355	
Taxes	7,741	
Transfer agent's, registrar's fees, etc.	2,300	
Directors' fees and expenses	1,602	
Legal	529	
Stationery, printing and postage	489	
Traveling	1,982	
Organization, portion charged off	937	
General	3,232	
Total		21,167
Net income		$808,734
Dividends:		
On prior preference stock	$314,705	
On preferred stock	378,092	
Total		692,797
Profit and loss surplus, June 30, 1914		$115,937

The Sierra & San Francisco Power Company received over 70 per cent of its gross earnings from energy sold to the United Railroads of San Francisco. The company's income statement for the year ended June 30, 1914, is as follows:

Gross earnings	$1,136,682
Operating expenses and taxes (including depreciation)	508,717
Net earnings	$627,965
Bond interest (including small item of uncollectible accounts)	374,762
Net income applicable to investment under terms of second mortgage	$253,203

The Coast Valleys Gas & Electric Company, which serves an area of approximately 500 square miles, showed an increase in net earnings which was not proportionate to the increase in gross owing largely to increased taxes and increased depreciation reserve. The earnings statement for the year ended June 30, 1914, is as follows:

Gross earnings:		
Electric		$165,626
Gas		43,791
Water		21,234
Miscellaneous		9,333
Total		$239,984
Operating expenses, depreciation and taxes:		
Operating expenses		$128,207
Depreciation		9,893
Taxes		11,013
Total		$149,113
Net earnings		$90,871
Deductions:		
Interest on first mortgage bonds		$51,207
Interest on underlying bonds		— 2
Interest on notes and accounts payable (net)		9,440
Uncollectible accounts		716
Total		$61,361
Net income for year		$29,510
Net income for period March 20, 1912-June 30, 1912		$5,118

United Fuel & Power Granted Time Extension.—The California Railroad Commission has extended the time in which the United Fuel & Power Company may issue $197,000 of stock, previously authorized by the commission, to Jan. 1, 1916.

UTILITIES AHEAD OF PREVIOUS YEAR

Companies Show Gain of 5 per Cent in Gross and 2 per Cent in Output

During October the central-station companies of New England, according to statistics received by the *Electrical World*, were ahead of last year in both income and output despite continued industrial depression. For the most part companies operating in the larger cities did very well, as did also the companies which conduct mostly a lighting business in the smaller communities. In most cases companies engaged in generating energy for commercial purposes in the smaller and medium-sized towns showed an increase over last year in gross receipts, but fell behind in kilowatt-hour output. It was owing mostly to the diversity of their load that the companies in the large cities did well, while the purely lighting companies did well because they were engaged in the manufacture of a necessity. The companies which reduced their output can attribute this principally to their very small diversity of load.

TABLE I—COMPARATIVE RETURNS COVERING 60 PER CENT OF THE CENTRAL-STATION INDUSTRY OF THE NEW ENGLAND STATES

	Income Derived from Sale of Energy			Energy Output in Kw-hr.		
	1914	1913	Per Cent Increase	1914	1913	Per Cent Increase
May	$1,704,102	$1,573,119	8.4	51,519,410	49,752,133	3.6
June	1,467,791	1,356,552	8.3	50,456,031	45,368,312	11.6
July	1,551,797	1,419,597	9.3	50,644,731	45,861,737	10.4
August	1,608,730	1,489,213	7.5	52,398,832	49,576,095	5.5
September	1,658,740	1,556,250	6.7	55,056,974	53,017,201	3.9
October	1,804,918	1,719,573	5.0	59,989,812	58,795,980	2.1

TABLE II—RETURNS FOR SEVEN-MONTH PERIOD FROM NEW ENGLAND ELECTRIC UTILITIES

	Income Derived from Sale of Energy			Energy Output in Kw-hr.		
	1914	1913	Per Cent Increase	1914	1913	Per Cent Increase
April (52 per cent of industry)	$1,501,773	$1,384,225	8.5	43,386,624	39,181,988	10.8
May (63 per cent of industry)	1,745,160	1,609,234	8.4	52,752,247	50,779,103	3.9
June (67 per cent of industry)	1,560,872	1,442,178	8.3	53,463,013	48,049,756	11.1
July (70 per cent of industry)	1,670,819	1,530,410	9.2	54,074,533	49,255,893	9.8
August (71 per cent of industry)	1,734,583	1,607,649	7.5	55,801,224	52,913,483	5.4
September (71 per cent of industry)	1,811,762	1,696,997	6.8	59,763,538	57,081,873	4.7
October (76 per cent of industry)	2,011,672	1,923,073	4.7	71,041,599	68,987,478	3.0

Business Notes

The Beacon Miniature Electric Company, New York, has changed its address from 108 Duane Street to 118 Duane Street.

The Diehl Manufacturing Company, Elizabeth, N. J., has appointed C. A. S. Howlett, formerly of the General Electric Company, vice-president.

The Reliance Electric & Engineering Company, Cleveland, Ohio, has appointed E. F. J. Lindberg, formerly of the Central Electric Company, as manager of its Chicago office.

The Goulds Manufacturing Company, Seneca Falls, N. Y., has opened an office at Atlanta, Ga. This office is in the Third National Bank Building and is in charge of O. B. Tanner, who is district manager.

The Robbins & Myers Company, Springfield, Ohio, has appointed C. R. Hunt, formerly with the General Electric Company, the Crocker-Wheeler Company and the Cutler-Hammer Manufacturing Company, and G. H. Gibbs, formerly with the Western Electric Company and the Westinghouse Electric & Manufacturing Company, in charge of its exhibits at the San Francisco and San Diego expositions respectively. At the close of the Panama-Pacific Exposition Mr. Hunt will maintain a permanent office in San Francisco. The New York offices of the above company have been transferred from 145 Chambers Street to 30 Church Street, Room 400. The warehouse of the company is at 155 Hudson Street.

New Industrial Companies

The Leindorf Electric Light Company, of New York, N. Y., has been incorporated by E. Leindorf, H. Trisch and J. Katz, of New York, N. Y. The company is capitalized at $25,000 and proposes to do an electrical and general contracting business.

The Baker Electric Motor Service Company, of Brooklyn, N. Y., has been incorporated with a capital stock of $20,000 by B. R. Spears, Frederick Bowers and F. A. Jennicky, 906 Eastern Parkway, Brooklyn, N. Y. The company proposes to deal in automobiles and boats.

Toll & Company, of New York, N. Y., have been chartered with a capital stock of $10,000 to manufacture electrical apparatus for dentists and physicians. The incorporators are Spencer E. Toll, N. M. Toll and K. H. Bissell; Morris Friedburg, 140 Nassau Street, New York, is attorney.

The Royal Electric Motor Company, of New York, N. Y., has been incorporated by Abraham Zwenitzky, Isaac Joffe and Benjamin Schwartz; Abraham Miles, 37 Graham Avenue, Brooklyn, is attorney. The company is capitalized at $9,000 and proposes to do a general electrical contracting business.

Trade Publications

Electric Toaster.—A small electric toaster is the subject of a leaflet sent out by the Cadillac Electric Manufacturing Company, Cadillac, Mich.

Electrical Devices.—Catalog No. 203, issued by the W. A. Bonnell Company, New York, contains information on a number of electrical devices.

Commutator Truing Device.—Jordan Brothers, Inc., New York, have issued a thirty-two-page illustrated catalog on a commutator truing device.

Electric Grinders.—Portable electric grinders are the subject of Bulletin No. 1 recently issued by the Atwater Electric Works, Coopersville, N. Y.

Sockets.—The Best Electric Company, Fifty-first Street and Harrison Street, Pittsburgh, Pa., is sending out a folder describing several types of lamp sockets.

Motorless Flasher.—The M. C. Ryan Company, Phoenix, N. Y., is sending out a folder containing information on several types of solenoid-operated flashers.

Electric Passenger Cars.—The Ohio Electric Car Company, Toledo, Ohio, has published an attractively illustrated catalog describing some of its passenger vehicles.

Lamp Guards.—A folder describing and illustrating several types of lamp guards for incandescent lamps has been issued by Harvey Hubbell, Inc., Bridgeport, Conn.

Battery-Operated Hand Lamp.—The Metal Specialties Manufacturing Company, Chicago, Ill., has issued several leaflets describing a lamp which can be attached to a dry cell.

Portable Electric Tools.—Motor-driven drills, buffers, grinders, etc., are described and illustrated in a catalog published by the Temco Electric Motor Company, Leipsic, Ohio.

Electric Toaster.—The P. J. Electric Heating Company, 332 South LaSalle Street, Chicago, Ill., is sending out a leaflet which gives a few of the features of its low-priced toaster.

Electric Passenger Cars.—The Anderson Electric Car Company, Detroit, Mich., has issued an attractively illustrated catalog describing its 1915-model pleasure automobiles.

Porcelain Devices.—The Illinois Electric Porcelain Company, Macomb, Ill., has published an illustrated catalog containing descriptions of knobs, cleats, tubes, insulators, etc.

Concrete Lighting Standards.—Morrison & Quinn, Inc., Rochester, N. Y., are sending out a booklet and sheet which contains information on ornamental concrete lighting standards.

Automatic Switch.—Bulletin No. 11 published by the Hartman Electrical Manufacturing Company, Mansfield, Ohio, describes an automatic cut-in and cut-out switch for small lighting plants.

Hand Lamp Operated by Dry Cell.—The Manhattan Electrical Supply Company, 17 Park Place, New York, has recently issued a folder which describes and illustrates a lamp operated by a dry cell.

Electric Devices.—The Union Electric Company, Hamilton Avenue, Trenton, N. J., has issued several folders which contain information on sockets, receptacles, pendent switches and snap switches.

Engine-Stopping Devices.—The Consolidated Engine Stop Company, 130 East Twelfth Street, New York, has issued several illustrated booklets which describe its engine-stopping and speed-limiting devices.

High-Frequency Generator.—The Bleadon-Dunn Company, 208 North Fifth Avenue, Chicago, Ill., has issued several bulletins which describe its recently developed "Violetta" high-frequency generator.

Portable Lighting Fixtures.—The C. Spiro Manufacturing Company, 68 East 131st Street, New York, has issued a leaflet describing a portable lighting fixture which can be attached to tables, desks, chairs, etc.

Porcelain Sockets.—A heavy porcelain socket equipped with aluminum shade holders is described in a folder recently issued by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago, Ill.

Removable Bracket.—"Hotel Sample-Room Lighting" is the subject of a folder recently issued by the Bryant Electric Company, Bridgeport, Conn., which contains information on a removable bracket for incandescent lamps.

Desk Push-Button System.—"The Edwards Directory Push" is the title of a folder recently issued by Edwards & Company, 140th and Exterior Streets, New York, which contains information on push-button stations for call systems.

Apparatus for Softening Water.—"Chemistry of Water Softening" is the subject of a booklet being sent out by the Kennicott Company, Chicago Heights, Ill. The booklet contains information on apparatus for softening, weighing and filtering water.

Insulating Compound.—The Flexible Compound Company, 3607 Haverford Avenue, Philadelphia, Pa., has issued a booklet which describes a compound which may be used as a binder for paint pigments and for treating coils, third-rails, transformers, etc.

Personal Mention

Mr. J. S. Pevear has resigned as president of the New Orleans (La.) Railway & Light Company. He is succeeded by Mr. D. D. Curran.

Mr. P. T. Glidden, manager of the Consumers' Power Company, St. Paul, Minn., has been elected president of the local Association of Commerce.

Mr. E. J. Bean, formerly attorney for the Public Service Commission of Missouri, has succeeded Mr. William F. Woerner as a member of the commission.

Mr. W. P. Hendricks, superintendent and master mechanic of the Elgin & Belvidere Electric Company, Marengo, Ill., has resigned to engage in other work.

Mr. H. L. Moss, formerly electrical engineer of the Elgin & Belvidere Electric Company, Marengo, Ill., has been appointed acting superintendent to succeed Mr. W. P. Hendricks, resigned.

Mr. A. N. Connett, chief engineer and a joint managing director of J. G. White & Company, Ltd., of London, has eccepted the position of a vice-chairman of the Belgian Relief Commission and will go to Brussels to take charge of the distribution of the food and other means of relief being sent to that country from America. Mr. Connett is now in this country, but expects to leave for London on Dec. 30 to receive instructions before going to Brussels.

Mr. H. Thurston Owens, until recently secretary and general manager of the San Diego (Cal.) Gas & Electric Appliance Company, has become associated with the lighting fixture house of Bayley & Sons, with headquarters at 101 Park Avenue, New York City. Mr. Owens has been in the lighting business for fifteen years with the Consolidated Gas Company, the city of New York and the *American Gas Light Journal* and was recently general manager of the La Crosse (Wis.) Gas & Electric Company. He has also been actively identified with the work of a number of gas and electric associations.

Mr. W. L. Locke, superintendent of construction of the Stone & Webster Engineering Corporation, has taken up his activities as head of the construction department at Seattle, Wash. Mr. Locke was in Seattle prior to his assuming charge of the transmission line from the Big Creek development project, in California, to Los Angeles, where he was put in charge of the Los Angeles office, under Mr. Shuffleton. Before going to the Big Creek project Mr. Locke had charge of local construction in Seattle for the engineering corporation which at that time did all of the construction work for the Seattle Electric Company.

Mr. E. E. Eysenbach has resigned as general manager of the San Antonio (Tex.) Traction Company and of the San Antonio Gas & Electric Company to devote attention to his private interests in Oklahoma. Mr. Eysenbach was formerly vice-president and manager of the Consolidated Gas Company of New Jersey, Long Branch, a consolidation of the Long Branch Gas Light Company and the Long Branch Electric Light Company. His duties at San Antonio will be taken over temporarily by Mr. W. B. Tuttle, vice-president of the companies. Before Mr. Eysenbach left San Antonio he was waited on by a committee and presented with a silver coffee service from the men as a token of their esteem.

Mr. D. D. Curran, now president of the New Orleans & Northeastern Railroad, has been elected president of the New Orleans (La.) Railway & Light Company to succeed Mr. J. S. Pevear, resigned. Mr. Curran, who is a railroad man of long experience, was born in Ireland. He entered railroad service in 1873 as a brakeman on the Pennsylvania Railroad, which position he held for five years. He was then successively freight conductor of the Mobile & Montgomery Railroad, passenger conductor of the same road, yardmaster of the Louisville & Nashville Railroad at Montgomery and trainmaster of the same road at Birmingham, Ala. From 1887 to 1893 Mr. Curran was connected with the Central of Georgia Railroad successively as superintendent of the South Carolina division, superintendent of the Southwestern division, superintendent of the Columbus & Western division and superintendent of the Savannah and Western division. He was appointed to the last-mentioned position in 1892. From February, 1893, to August, 1907, he was superintendent of the New Orleans & Northeastern Railroad. In August, 1907, he was elected president of that company.

Mr. Alonzo Rogers Weed, a member of the Massachusetts Gas and Electric Light Commission since 1906, has been designated chairman of the board by Governor Walsh to succeed the late Forrest E. Barker. The new chairman was born in Bangor, Maine, in 1867, and was graduated from Harvard College in 1887, receiving the degree of LL.B. from Boston University in 1890, in which year he was admitted to the Massachusetts bar. Mr. Weed practised law in partnership with his brother, Mr. G. M. Weed, at Boston until 1906, and in 1907 became a member of the firm of Brewer, Weed & Weed, Boston. He was at one time instructor in equity in the Boston University Law School, and from 1902 to 1913 was instructor in equity pleading at the same institution, becoming acting dean in 1911. From 1899 to 1903 he was a member of the Newton (Mass.) Board of Aldermen, serving as president in the latter year. In 1904-5 Mr. Weed was Mayor of Newton, becoming a member of the Gas and Electric Light Commission in the year following. In politics he is a Republican and is a member of the Hunnewell Club of Newton and of the Boston City Club. The new chairman's eight years of service upon the board have thoroughly familiarized him with its problems, and in the important codification of laws relating to the production and distribution of gas and electricity which was approved by the last Legislature Mr. Weed bore large responsibilities. Like his predecessor, Mr. Weed possesses under a quiet exterior keen analytical powers and a broad comprehension of technical matters in addition to distinguished legal qualifications. His home is at Newton.

Obituary

Gen. Thomas Sherwin, chairman of the board of directors and for twenty-five years president of the New England Telephone & Telegraph Company, died at his home in Boston, Mass., on Dec. 19. He was a native of Boston and was graduated from Harvard College in 1860 at the age of twenty-one. General Sherwin had a notable Civil War record, being brevetted brigadier-general at its close for gallant and meritorious services. He was associated with the development of the telephone business practically from its inception, and for twenty-three years was auditor of the American Bell Telephone Company. He was a man of the highest character and ability, had a delightful personality, and was a director in numerous industrial corporations.

William H. Coughlin, whose death was noted in the *Electrical World* of Dec. 19, was widely known in the New England central-station field. Although Mr. Coughlin belonged to the old school of central-station men, in which operating problems and the pursuit of economies in generating plant service took precedence over purely commercial interests, the Worcester (Mass.) Electric Light Company developed under his able direction along sound lines which furnished a firm basis upon which the remarkable recent expansion of the system has been built. Primarily a steam engineer, Mr. Coughlin supervised the physical growth of the Worcester system with skill and loyalty, and the commercial development which took place during the years of his service, while largely stimulated from without, was guided by him into profitable channels with a practical appreciation of the importance of service extension which was none the less real because his own talents lay along more technical lines. A frequent attendant at conventions of the National Electric Light Association, Mr. Coughlin was always a good listener, and although he was reluctant to express himself before an audience, many a central-station man owes much to his homely, shrewd and penetrating comment upon electrical affairs as advanced in informal conversations outside the session hall. For many years he was virtually general manager of the Worcester company, and his passing removes one more figure associated with early central-station history whose quiet influence was a factor to be reckoned with in the development of the great industry of to-day.

Construction

New England

MARLBORO, MASS.—Plans are being considered for the installation of an ornamental street-lighting system on Main Street.

WALTHAM, MASS.—Plans are being considered for improving the street-lighting system and the installation of additional ornamental lamps.

PROVIDENCE, R. I.—Plans have been prepared for the construction of an addition to the art school for the Rhode Island School of Design (to cost $250,000), to be located on North Main Street. The project also includes a power house.

WINSTED, CONN.—Plans have been prepared for an addition to the power station of the Winsted Gas Co. by E. H. Waterbury, of Torrington. The building will be 20 ft. by 64 ft.

Middle Atlantic

BEACON, N. Y. (not a post office).—The installation of a municipal electric-lighting plant in Beacon is under consideration.

BERGEN, N. Y.—The Village Board has approved the contract presented by the Niagara, Lockport & Ontario Pwr. Co., of Buffalo, to supply electricity to operate the municipal electric-lighting system.

BROOKLYN, N. Y.—Bids will be received by William Williams, commissioner of Water Supply, Gas and Electricity, Municipal Building, New York, until Dec. 31 for reserving and furnishing electrical generating capacity, current and equipment for use of the high-pressure fire-service pumping stations for the year 1915. Blank forms of bid, proposals and contract, including specifications, can be obtained at Room 2324, Municipal Building, borough of Manhattan.

BUFFALO, N. Y.—If a plan proposed by the Department of Public Works and passed by the Common Council meets the approval of the Mayor, an electric-light and power plant will be installed at the new pumping station at the foot of Porter Avenue. The proposed plans provide for the development of 250 hp at a cost of about $50,000.

DUNKIRK, N. Y.—The contract for furnishing the lighting fixtures (300) for the new street-lighting system has been awarded to the Adams-Bagnall Co., of Cleveland, at $6.40 each. The Westinghouse El. & Mfg. Co., of Pittsburgh, Pa., will furnish the incandescent lamps.

ELBA, N. Y.—The Genesee Lt. & Pwr. Co., of Batavia, it is reported, is contemplating extending its lines to Elba to furnish electrical service here.

LANCASTER, N. Y.—The Depew & Lancaster Lt., Pwr. & Conduit Co., of Lancaster, is planning to extend its transmission lines to West Seneca to furnish electricity for street-lighting and for commercial purposes. The proposed substation will be located at Gardenville and equipped for receiving energy at 11,000 volts, three-phase, 25 cycles, and distributing it at 2200 volts, including necessary transformers, regulators, switchboards, etc., for distributing electricity for street-lighting system (tungsten lamps) and for lamps and motors for commercial purposes. About 500 poles with necesary line wire, hard wire, street fixtures, transformers, etc., will be required. Contracts have already been placed for meters and for 306 tungsten lamps of 60 cp with fixtures. The company will install the equipment but would like to receive prices on the above apparatus and material. A. R. Tremaine is superintendent.

MECHANICSVILLE, N. Y.—The Public Service Commission has given its approval of the franchise of the Mechanicsville El. Lt. & Gas Co. from the town of Schaghticooke, and has also granted permission to exercise the same under a contract with the town for lighting Hemstreet Park and the eastern portion of the bridge from Mechanicsville.

NEW YORK, N. Y.—Bids will be received by William Williams, commissioner of Department of Water Supply, Gas and Electricity, Municipal Building, New York, N. Y., until Dec. 31 for reserving and furnishing electrical generating capacity, current and equipment for use of the high-pressure fire-service pumping stations for the year 1915. Blank forms of bid, proposals and contract, including specifications, can be obtained at Room 2324, Municipal Building, borough of Manhattan.

PLEASANT VALLEY, N. Y.—The J. B. Thompson Co. is contemplating enlarging the electric plant at its mill to supply electricity for lighting the streets of the town.

POLAND, N. Y.—Plans are being considered by the officials of the villages of Poland and Cold Brook for the construction of a joint electric-light plant to serve both villages. It is proposed to build the plant on Cold Brook stream.

STILLWATER, N. Y.—The residents have petitioned the Town Board to install an electric-lighting system in the "Frog Island" district.

WATERTOWN, N. Y.—The capital stock of the New York Utilities Co., of Watertown, has been increased from $1,000,000 to $2,000,000. The company proposes to supply electricity and gas in Jefferson, Lewis, Oneida, Oswego and St. Lawrence Counties.

ALLENTOWN, PA.—Bids will soon be asked for electrical equipment for the new high school building now being erected in this city at a cost of $500,000.

ALLENTOWN, PA.—Work has been started on the construction of a new armory in Allentown, to cost about $50,000. The building will be lighted by electricity.

CAERNARVON, PA. (not a post office).—Application has been made to the Governor by George L. Nies, William Sweigart and D. S. Martin on Dec. 18 for a charter for the Caernarvon El. Lt. & Pwr. Co. The company proposes to supply electricity for lamps, heaters and motors in Caernarvon Township.

EASTON, PA.—The Hart Chemical Corpn., recently organized, will begin work on the erection of a large plant next spring for the manufacture of potash and a line of chemicals similar to those until recently imported into this country from Germany. Electrically operated machinery, it is said, will be used throughout the proposed plant. Dr. Edward Hart, professor of chemistry at Lafayette College, Lafayette, Ind., is president, and Gilbert Dannehower is mechanical engineer.

HAZLETON, PA.—The Harwood El. Co., of Hazleton, has awarded the contract for rebuilding its transmission line from Harwood to Hauto to Rodney D. Allen. During the recent storm 5 miles of steel towers, on which were erected high-tension wires, were blown down.

KUTZTOWN, PA.—The Borough Council has voted to erect a new municipal electric plant to supply electricity for both municipal and commercial purposes, at a cost of about $23,000, bonds for which were voted last November. The present plant will be operated until the new plant is completed. F. A. Moyer is chairman of the electric-light committee.

LANSFORD, PA.—The Panther Valley El. Lt., Ht. & Pwr. Co., of Lansford, has recently awarded a contract to the General Electric Co. for the following apparatus: 600 kw in substation transformers, 20 switchboard panels, four 75-lamp tub transformers, with lamps, lightning arresters, etc. The company receives energy at 1100 volts, 60 cycles, from the Lehigh Navigation El. Co.

LAURELTON, PA.—Plans, it is reported, are being prepared for the construction of a power house in Laurelton, to cost about $6,000.

MONACA, PA.—Plans are being considered by the City Council for the purchase of the distributing systems of the Monaca El. Co. and the Beaver County Lt. Co., which at present supply electricity here. The city is contemplating the installation of a municipal electric plant. The contract with the above companies expires Sept. 1, 1916.

MOUNT UNION, PA.—The Council has recently closed a contract with the Raystown Wtr. Pwr. Co., of Raystown, for lighting the streets of the town for a period of ten years with the privilege of renewal of two additional terms of five years each. The contract calls for nitrogen-filled tungsten lamps of 400 cp and 100 cp.

SOUTH BETHLEHEM, PA.—The Borough Council has passed an ordinance authorizing the borough officials to enter into a contract with the Lehigh Valley Lt. & Pwr. Co., of Allentown, to light the streets of the borough for a period of five years. A. H. S. Cantlin is general manager of the company.

CAMDEN, N. J.—Contracts, it is reported, will soon be awarded by the Victor Talking Machine Co. for extensions to its plant in Camden, to cost about $1,000,000. The work, it is understood, will include a restaurant, hospital and power plant. Louis F. Geissler is general manager.

BALTIMORE, MD.—The Board of Awards has awarded the contract for furnishing electricity for operating and lighting the filtration plant at Lake Montebello, at about $40,000 per year.

HUNTINGTON, W. VA.—The Chesapeake & Ohio Ry. Co., it is reported, is contemplating equipping its Guyandotte Valley branch for electrical operation during the coming year. It is proposed to use electric locomotives, securing the energy from either an overhead trolley or a third-rail.

CLIFTON FORGE, VA.—The Virginia-Western El. Co., of Clifton Forge, it is reported, is contemplating extending its transmission lines to Buchanan.

RICHMOND, VA.—Arrangements have been made by the State Lime Board with the Staunton El. Co. for furnishing electricity for lamps and motors for the plant. Electric lamps will be placed in the houses which will house the convicts and officers in charge of the plant. At present steam power is used.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 7 for furnishing five exterior lamp standards for the United States Bureau of Engraving and Printing, Washington, D. C., in accordance with plans and spscifications, copies of which may be seen at the above office. O. Wenderoth is supervising architect.

WASHINGTON, D. C.—In his report Gen. Dan C. Kingman, chief of engineers, has renewed the recommendation of his predecessors in office looking to the utilization of the water of the Great Falls of the Potomac to generate electricity for the District of Columbia. He asks Congress for an appropriation of $3,000,000 for preliminary work, of which $1,000,000 is to be applied to construction needed for increased water supply and $2,000,000 for construction of power plant.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 12 for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 7734—miscellaneous engine indicators and accessories; Schedule 7727—miscellaneous insulating material; Schedule 7740—four 36-in. parabolic searchlight mirrors; Schedule 7726—three meat and food choppers, one dish-washing machine, one dough-mixing machine and one kitchen and cake machine, all to be electrically operated; Schedule 7740—miscellaneous rolled naval bar brass, 1700 lb. hard-drawn bar copper; Schedule 7728—746 unfinished heavy brass unions. Norfolk, Va., Schedule 7728—1700 ft. interior communication cable, 2650 ft. lighting and power wire. Washington, D. C., Schedule 7725—six retorts; Schedule 7735—miscellaneous single-conductor and rubber-covered copper wire. Philadelphia, Pa., Schedule 7735—5000 ft. flexible cord for portables. Charleston, S. C., Schedule 7721—two motor-driven buffing lathes. Newport, R. I., Schedule 7733—300 lb. hard-drawn, seamless brass tubing. Bids will also be received at the same place until Jan. 19 for the following: Washington, D. C., Schedule 7745—one motor-driven, high-speed drill. Puget Sound, Wash., Schedule 7744—miscellaneous hard, not tinned, sheet copper; Schedule 7742—miscellaneous black and galvanized wrought-iron pipe. Mare Island, Cal., Schedule 7744—miscellaneous pipe fittings, 3000 lb. 1½-in. seamless drawn brass pipe and 240 1½-in. composition unions. Applications for proposals should designate the schedule desired by number.

North Central

AKRON, MICH.—The town of Akron is contemplating the installation of a municipal electric-light plant.

BATTLE CREEK, MICH.—Within the next six months the Citizens' El. Co. expects to purchase a 1500-kva turbine and boilers having a rating of about 1000 hp. D. H. Beardsley is superintendent.

CARLETON, MICH.—The Town Council is considering the question of lighting the town by electricity.

DETROIT, MICH.—The City Council has authorized George Engle, city controller, to issue $350,000 in bonds, the proceeds to be used for improvements to the lighting system.

SHERWOOD, MICH.—The Council has granted Mr. Latchan permission to install an electric-lighting system in Sherwood.

ALLIANCE, OHIO.—The trustees of the Fairmount Children's Home have awarded the contract to furnish electricity for lamps and motors at the Fairmount Children's Home to the Alliance Gas & Pwr. Co. The present steam plant will be discarded and motor-driven pumps will be installed and the laundry equipment will be operated by electricity.

CANAL DOVER, OHIO.—The installation of an additional 350-hp gas engine and generator, to cost about $20,000, will be recommended to the City Council by Fred

Warther, chief engineer. An addition to the present power station will be necessary to provide space for the proposed generating unit.

CINCINNATI, OHIO—Plans are being prepared by Zittel & Rapp, architects, for a new service station for electric vehicles, for Charles Behlen & Sons, on Rockdale Avenue. The building will be 50 ft. by 100 ft.

CINCINNATI, OHIO.—Spear & Co., Fifth Street and Central Avenue, furniture dealers, have leased a building on Race Street, which will be remodeled at once. The proposed improvements will include the installation of additional elevators and an electric-light plant, to cost about $15,000.

DAYTON, OHIO—Petitions are being circulated among property owners on a number of additional streets to secure the extension of the proposed ornamental street-lighting system.

EAST LIVERPOOL, OHIO.—The City Council is contemplating the installation of a municipal electric-light plant, to cost about $60,000, plans for which have been prepared.

ELYRIA, OHIO.—The Lorain County El. Co., of Elyria, has applied to the Public Utilities Commission for permission to increase its capital stock from $10,000 to $3,000,000, with a view of establishing a power station and developing the territory surrounding Lorain and Elyria into a manufacturing district. The company also asks for permission to issue $3,000,000 in bonds, the proceeds to be used to purchase the holdings of Henry A. Doherty, which include the Citizens' Gas & El. Co. and the Elyria Milling & Pwr. Co. Additional generating plant, transmission lines and distributing systems are contemplated. The proposed power plant will have a generating capacity of 15,000 kw, which will feed approximately 100 miles of transmission lines through substations. The Doherty company owns the Baltimore & Ohio power plant in Lorain, which will be enlarged and made the chief distributing point.

GALLIPOLIS, OHIO—The Indian Guyan Coal Co., recently organized with a capital stock of $300,000 to operate coal-mining properties near here, it is understood, proposes to build a hydroelectric power plant on the Ohio River. The proposed plant will have an output of 3000 hp, which will be used in connection with mining operations and to operate an electric railway. S. L. Fedder, of Cleveland, and others are interested in the company.

RIPLEY, OHIO.—The City Council, it is reported, has appointed a committee to make investigations as to the feasibility of purchasing the local electric-light and gas plant, to be owned and operated by the municipality.

ST. PARIS, OHIO.—The Dayton Lt. & Pwr. Co., of Dayton, is negotiating with the Village Council for the purchase of the municipal electric-light plant, or furnishing electricity to operate the local system. If the plant is taken over by the company energy for operating the local system will be supplied from the power house in Piqua.

TIFFIN, OHIO.—The Ohio Lt. & Pwr. Co., of Tiffin, proposes to use the proceeds of $1,200,000 in bonds for the erection of transmission lines connecting its various properties into main operating groups. The company operates in 11 municipalities in Ohio.

WILMINGTON, OHIO—Preparations are being made by the Dayton Lt. & Pwr. Co. for improvements to the local electric plant, which it recently acquired from the Wilmington Wtr. & Lt. Co. The purchase of the property of the Cedarville Lt. & Pwr. Co., of Cedarville, is also contemplated by the Dayton company. If the sale is approved by the Public Utilities Commission, additional equipment will be installed at the plant.

YOUNGSTOWN, OHIO.—The Public Utilities Commission has granted the Mahoning Lt. & Pwr. Co. permission to purchase the plant of the Youngstown Htg. Co., at $125,000. The commission also granted the Mahoning company authority to sell $530,000 in bonds at 90 and to issue $500,000 in capital stock, the proceeds to be used for the construction of the new plant.

HOPKINSVILLE, KY.—The new central generating station of the Kentucky Pub. Ser. Co. at Hopkinsville is completed. The old plants of the company will be closed down and service supplied from the new station, which in addition to supplying energy in Hopkinsville will also furnish service in Clarksville, Tenn., Pembroke and Trenton, Ky.

STURGIS, KY.—The West Kentucky Coal Co., it is reported, has decided to rebuild its power plant in Sturgis, which was recently destroyed by fire, causing a loss of about $20,000.

VINE GROVE, KY.—The capital stock of the Citizens' Ltg. Co. has been increased from $3,000 to $5,000.

INDIANAPOLIS, IND.—After receiving reports on tests made by the city engineer the Board of Public Works has notified the Merchants' Lt. & Ht. Co. to use the flaming-arc lamps in fulfilling its contract with the city.

MILFORD, IND.—A franchise, it is reported, has been granted to Emil Stroh to operate an electric-light and power system in Milford Township.

PENNVILLE, IND.—Steps have been taken by citizens of Pennville to organize a company to establish an electric-light plant in Pennville.

PERU, IND.—The City Council has authorized the Electric Light Department to extend the municipal electric lines to Loree and Crider Chapel, a distance of 7 miles, to furnish electrical service to the farmers in that district.

EAST DUBUQUE, ILL.—The generating plant of the municipal electric-lighting system has been closed down and electricity for operating the system is purchased from the Union El. Co., of Dubuque, Ia. R. T. Stewart is superintendent.

GRANVILLE, ILL.—Sidney Whitaker, owner of the local electric-light plant, is installing a 120-hp Chuse non-releasing Corliss engine.

LOUISVILLE, ILL.—I. N. Stanford & Son, of Louisville, are contemplating the installation of an ice factory in connection with the water and light plant next spring.

MOUNT VERNON, ILL.—The Citizens' Gas, El. & Htg. Co., of Mount Vernon, has recently installed a 100-kw General Electric rotary converter to supply electricity to operate the system of the City Railway Co. H. E. Brandli is general manager.

BELOIT, WIS.—Plans are being considered for the installation of an ornamental street-lighting system in the business district.

LADYSMITH, WIS.—W. D. Morgan, city engineer, would like to receive prices on one chemical wagon fire extinguisher and an electrically operated general fire alarm or siren.

SHAWNO, WIS.—All bids for proposed new wells and pipe line to river have been rejected, owing to being too high. The work will not be done this year. Paul Caparo is superintendent of the city water and light plant.

HIBBING, MINN.—The installation of a new municipal electric-light plant in Hibbing is reported to be under consideration.

MAPLETON, MINN.—Within the next four months C. L. Sellers, owner of the local electric-light plant, expects to erect about 10 miles of transmission line and to purchase transformers, lightning arresters, insulators and wire for above line and about 125 meters and also a general supply of electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, wiring supplies and switches.

MINNEAPOLIS, MINN.—Bids will be received at the State Board of Control, State Capitol Building, St. Paul, until Jan. 7 for construction of Biology Building at the University of Minneapolis, including general contract work, heating and ventilating, plumbing and electrical work, in accordance with plans and specifications prepared by C. H. Johnston, architect, 715 Capital Bank Building, St. Paul. Bids will be received collectively and separately. Copies of plans and specifications may be seen at the Builders' Exchanges in St. Paul, Minneapolis and Duluth, at the office of the State Board of Control, and at the office of the comptroller of the University of Minnesota, Minneapolis.

ST. PAUL, MINN.—The Commissioner of Public Utilities has authorized August Hohenstein, purchasing agent, to advertise for bids for nitrogen-filled lamps. It is expected that about 400 old-style arc lamps will be replaced by these new lamps. About 200 additional lamps will be placed in new locations. Bids for energy to maintain the city lamps will be asked for shortly.

HUMBOLDT, IA.—Work has begun on the erection of a transmission line by the Northern Iowa Pwr. Co. to supply electricity in the towns of Livermore, Luverne and Corwith. The company has also made arrangements to supply electrical service in Havelock.

LEON, IA.—Preparations are being made by the Leon El. Co. for the erection of an electric transmission line to Osceola and the installation of a new engine and generator in its plant. Arrangements have been completed whereby the Leon company will supply electricity to operate the system of the Osceola Lt., Ht. & Pwr. Co. Electrical service will also be supplied to the towns of Van Wert and Weldon.

RUSSELL, IA.—The Union Service Co., of Chariton, is reported to have been granted a franchise to supply electricity in Russell. A transmission will be erected from Chariton to Russell.

TIPTON, IA.—At an election held recently the citizens voted in favor of municipal ownership of the electric light and power plant.

URBANA, IA.—Bonds to the amount of $3,000 have been voted for the installation of an electric-lighting system.

BRUNSWICK, MO.—The Brunswick Lt. & Wtr. Co. is installing one 150-hp boiler, a Murray Corliss engine, one single-acting triplex pump (motor driven) and one 15-hp Fort Wayne motor. Lincoln A. Nickell is manager.

CAMERON, MO.—Plans for improvements to the municipal electric-light plant, it is reported, are being prepared by Harper & Stiles, 911 Grand Avenue Temple, Kansas City, Mo. The plans provide for improvements to power house and installation of new machinery.

GRANT CITY, MO.—John W. Ewing and W. C. Childers, who recently have taken over the property of the Grand City Lt. & Pwr. Co., are building a new power house and installing an oil engine.

JAMESPORT, MO.—Plans are being considered for the installation of a municipal electric-light plant in Jamesport. It is understood that nothing will be done until next spring.

MARSHFIELD, MO.—Within the next two months the Marshfield El. Co. expects to erect a small machine shop, the equipment to consist of one 10-ft. bed lathe, shaper welding outfit and press drill, gasoline engine and motor. John E. Hosmer is secretary and treasurer.

STOUTSVILLE, MO.—The installation of a municipal electric-light plant in Stoutsville is under consideration.

FAIRBURY, NEB.—The transmission line of the municipal electric-light plant to Jansen (12 miles long), where electrical service will be furnished, is nearly completed. The electric-light commissioners are negotiating with several towns to furnish electricity from the municipal electric-light plant. A new 75-kw alternator and one switchboard panel have recently been installed at the municipal plant. G. D. Myers is manager.

BONNER SPRINGS, KAN.—The Kansas City, Kaw Valley & Western Ry. Co., operating an electric railway from Bonner Springs to Lawrence, Kan., will, it is reported, ask for bids about Jan. 1 for completing 21 miles of railway, including grading, laying track and erection of power line.

COLUMBUS, KAN.—The installation of a municipal electric-light plant in Columbus is under consideration.

GAYLORD, KAN.—The city of Gaylord is reported to have decided to install a municipal lighting system, at a cost of $7,000.

MUSCOTAH, KAN.—The city of Muscotah is contemplating the installation of a municipal electric-light plant.

PARSONS, KAN.—The Parsons Ry. & Lt. Co. has submitted to the City Commission for approval a plan which would provide the city with a better system for lighting streets and alleys at approximately the same cost. If adopted by the city, a ten-year contract will be asked.

Southern States

WHITEVILLE, N. C.—The City Council has accepted the proposal submitted by J. D. Maultsby, for the Whiteville Lt. Co. Under the present plan the company will furnish electricity for lighting the streets and the cost of installing the equipment will be paid by the property owners.

SMYRNA, GA.—The Nickajack Sand Co., it is reported, has engaged William T. McCormick, Rome, Ga., to prepare plans for remodeling its hydroelectric plant.

MILTON, FLA.—Within the next 12 months the water, light and sewerage committee expects to install a 100-kva, 60-cycle, 2300-volt engine-driven generating unit and to purchase material for about 1½ miles of transmission line, including transformers. H. A. Mentz is engineer.

NEWPORT, TENN. — The Carolina, Greenville & Northern R. R. Co., recently incorporated with a capital stock of $1,500,000, is planning to build an electric railway from Kingsport to Newport, a distance of 30 miles. Right-of-way has been secured for a considerable distance. H. S. Reed, of Los Angeles, Cal., is president.

GURDON, ARK.—Preliminary plans and estimates of cost for the installation of a municipal electric-light plant, water-works

and sewer system have been prepared. The proposal will be submitted to the voters on Jan. 15.

GRETNA, LA.—The City Council has granted Robley S. Stearns a franchise to supply electricity in Gretna, and also a contract for lighting the streets of the city. Plans, it is said, are being made by Mr. Stearns to organize a company to take over the franchise and contract. Work will begin immediately on the erection of the plant.

WEST MONROE, LA.—The contract for the construction of an electric-light plant and for improvements to the water-works system, it is reported, has been awarded to C. A. Rees, of Shreveport, at $16,000.

YALE, OKLA.—The proposal to issue $32,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters. H. Askin, of Cushing, is engineer.

LOCKNEY, TEX.—The property of the Lockney Lt. & Pwr. Co. has been purchased by William McGhee. Improvements to the system, including the installation of a new engine, will be made by the new owner.

MARBLE FALLS, TEX.—The Colorado River Pwr. Co. is planning to erect an electric transmission line from its hydro-electric power plant, now under construction at Marble Falls, to Houston and other cities and towns.

ORANGE, TEX.—Preparations are being made by the Orange Ice, Lt. & Wtr. Co. for extensions to its plant, work on which will begin March 1, 1915. The plans provide for the installation of one 75-kw and one 150-kw, three-phase, 60-cycle generator (not yet purchased). H. A. Burr is president.

SMITHVILLE, TEX.—Plans are being considered, it is reported, by Donald E. McKee, electrician, for the construction of an electric-light and power plant in the eastern part of the State. The proposed plant will have an output of about 400 hp, to be driven by steam or gas engines.

Pacific States

EVERETT, WASH.—The Everett Trades Council has recently passed a resolution asking the city of Seattle to extend its electric-lighting and water service to Everett.

EVERETT, WASH.—The County Commissioners of Snohomish County have granted the Jim Creek Wtr., Lt. & Pwr. Co., of Arlington, a franchise to lay pipes and electric distributing systems under and over certain county roads, to enable the company to extend its service to a number of points in Snohomish County. Work on the proposed extensions and improvements, it is understood, will begin soon after the first of the year.

SEATTLE, WASH.—The estimate submitted to the City Council by J. D. Ross, superintendent of lighting, on the use of municipal energy, in place of that of the Puget Sound Trac. Lt. & Pwr. Co., to operate the Seattle, Renton & Southern railway under municipal ownership places the cost at $29,780. In addition, more than $100,000 will be required for pole-line construction, extra feeder system, necessary substations and electrical equipment to give adequate voltage at all points on the line. This last estimate is based on the theory that the city will operate 36 cars instead of 26 cars, the number now in service.

SPOKANE, WASH.—The installation of 40 additional arc lamps, making the total 1400, has recently been ordered by Mayor Fassett. Bids will soon be asked for lamps and installation of same.

GOLD HILL, ORE.—Bids will be received by B. G. Harding, recorder, Gold Hill, until Jan. 4 for installation of a street-lighting system for the city.

AUBURN, CAL.—Plans are being considered by the Board of City Trustees for the installation of a municipal electric-light plant.

CALIPATRIA, CAL.—Plans are being considered by the Chamber of Commerce for the installation of a street-lighting system in Calipatria.

CUCAMONGA, CAL.—The Ontario Pwr. Co. of Ontario, it is reported, has submitted a proposal to the Council offering to install electric lamps from Base Line to the Santa Fé depot, provided that the city will sign a five-year contract.

STOCKTON, CAL.—The City Council has accepted the bid of the Western States Gas & El. Co. for lighting the streets and boulevards for a period of five years from Dec. 15, 1914. The contract will cover the present system and certain additional lighting.

DOWNEY, IDAHO—The City Council is contemplating the installation of a street-lighting system, work on which will begin soon.

SODA SPRINGS, IDAHO.—At an election to be held Dec. 28 the proposal to issue $15,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters. J. F. Woodall is chairman of board.

GREEN RIVER, UTAH.—Bids will be received by the Green River Irrigation District, Green River, until Jan. 4 for bare and insulated copper wire, insulators, pins, cross-arms and other line material for 7 miles of transmission and distribution lines for the electric-lighting system to be installed in Green River. Also for furnishing and installing hydraulic machinery and electrical apparatus for the power house of the Green River Irrigation District, and for 275 cedar poles from 30 ft. to 35 ft. in length. Plans and specifications may be obtained from S. J. Moor, city clerk.

HOLBROOK, ARIZ.—The installation of an electric-light plant is under consideration. L. S. Frith, of Gallup, N. M., is reported interested in the project.

JEROME, ARIZ.—The Arizona Pwr. Co., of Clifton, has extended its transmission lines to the smelter of the United Verde Copper Co., at Clarksville, near Jerome. Other extensions are contemplated by the Arizona company.

LUSK, WYO.—Preparations are being made for the installation of a municipal electric-light plant in Lusk, for which bonds have been voted.

PUEBLO, COL.—The Arkansas Valley Ry., Lt. & Pwr. Co., of Pueblo, it is reported, has secured a contract from the El Paso Consol. Gold Mining Co. to furnish 150 hp to operate hoists; electrically operated compressor will be installed later.

WHITE OAKS, N. M.—The Wild Cat Leasing Co. is constructing a new electric power plant near White Oaks, as supplemental to its present plant, increasing its output to 1100 hp. The company is extending its transmission lines to the properties of the Parsons Mining Co. and the American Mining Co.

Canada

BANFF, ALTA.—Plans have been prepared by C. H. Mitchell, consulting engineer of the water-power branch, Department of the Interior, Dominion of Canada (at the request of the Canadian Pacific Ry. Co.), for a hydroelectric installation in the Rocky Mountains, at Banff.

FORT GEORGE, B. C.—The local electric-light plant of the Northern Interior Pwr. Co. was recently destroyed by fire.

VICTORIA, B. C.—The fire warden's committee of the City Council has recommended the installation of a new fire-alarm system, to cost about $10,000.

BROCKVILLE, ONT.—Work will soon begin by the Hydro-Electric Power Commission of Ontario on the construction of an auxiliary power house at Brockville, to cost about $4,000. The station will be equipped with transformers to step down the energy received at 26,400 volts over the new transmission line now under construction, from Prescott, to 2200 volts.

ORILLIA, ONT.—The Council has requested the Water and Light Commission to install fifty 100-watt tungsten lamps on Main Street from Andrew Street to the lake. It is proposed to use the poles of the telephone company.

OTTAWA, ONT.—The McDonald Hydro-Electric Htg. Co., Ltd., has been granted permission to operate in Ottawa.

SMITHVILLE, ONT.—At a public meeting held recently the ratepayers decided to request the Hydro-Electric Power Commission to prepare an estimate of the cost to supply electricity for lamps and motors to the village and surrounding territory.

New Incorporations

DOVER, DEL.—The Nevada-California El. Corpn. has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $30,000,000 and proposes to organize syndicates, associations and corporations, to construct and operate telephone and telegraph lines, oil and gas plants and to generate and distribute electricity. The incorporators are Lawrence C. Phipps, Guilford S. Wood, W. E. Porter and H. D. Thatcher, all of Denver, Col.; Arthur B. West and Rodney Curtis, of Riverside, Cal.

STANLEY, N. D.—The Stanley El. Co. has been incorporated with a capital stock of $10,000 by N. G. Nelson, O. M. Kilen and A. G. Holn, all of Stanley.

MONTPELIER, VT.—The Ithiel Falls Pwr. Co. has been incorporated by Bancroft Abbott, of Norwood, Mass.; Charles H. Thompson, Benjamin A. Sumner, both of Montpelier, and Frank A. Walker, of Barre. The company is capitalized at $150,000 and proposes to develop water-power and generate electricity at a plant to be built on the Lamoille River.

RICHLANDS, VA.—The Richlands Ser. Corpn. has been incorporated with a capital stock of $25,000 to construct and operate gas plants.

TACOMA, WASH. — The Molander-Hawaiian Pwr. Co., of Tacoma, has filed articles of incorporation with the county auditor. The company is capitalized at $250,000 and proposes to develop electricity and distribute same in Tacoma and vicinity. The incorporators are George C. Bratt, H. A. Frauens and Samuel Cassimer, all of Tacoma.

FAIRWEATHER, WIS.—The Fairweather El. Co. has been incorporated with a capital stock of $25,000. The incorporators are: John Laper, John O. Laper and Jesse W. Laper.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 15, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,020,668. FLASHLAMP ATTACHMENT FOR ELECTRIC BATTERIES; F. Basedow, Chicago, Ill. App. filed June 4, 1914. Miniature lamp with switch clamped to terminals of battery cell.

1,120,708. CURRENT-CONTROLLING APPARATUS; E. L. Gale, Sr., Yonkers, N. Y. App. filed May 1, 1905. Motor starter.

1,120,709. AUTOMATIC STARTER FOR ELECTRIC MOTORS; E. L. Gale, Sr., Yonkers, N. Y. App. filed May 26, 1905. Has manual switch for successively closing circuits in certain order.

1,120,712. CONTACT-MAKING MECHANISM; C. I. Hall, Chicago, Ill. App. filed March 10, 1913. By which a slow-moving part makes instantaneous contact.

1,120,728. ELECTRIC BRAKE; W. D. Lutz, Allendale, N. J. App. filed March 20, 1912. Alternating-current brake for elevators.

1,120,748. HOLDER FOR X-RAY TUBES; E. N. Ryder, Brewster, N. Y. App. filed Dec. 19, 1913. By which the rays can be directed upon the head of a patient.

1,120,758. HOT-MEAL SERVER; C. Stirn, San Francisco, Cal. App. filed March 17, 1914. Electric heater keeps food heated while on table.

1,120,769. LAMP ATTACHMENT FOR FIREARMS; O. F. Villarejo, Milwaukee, Wis. App. filed Dec. 26, 1913. Attachable to ordinary revolver.

1,120,781. THERMO-ELECTRIC HEATING AND COOKING BODY; H. W. E. Altenkirch, Fredersdorf, and G. R. Gehlhoff, Danzig-Langfuhr, Germany. App. filed April 3, 1912. Concentric thermo-electric couples with the hot joint of one couple adjacent to the cold joint of another couple.

1,120,805. CIRCUIT-CLOSING MECHANISM; T. Gibson, G. A. Farmer and E. Read, Burton-Upon-Trent, Eng. App. filed May 29, 1913. Carried by train and operated by ramp rail.

1,120,811. COIL INSULATING DEVICE; E. Haefely, Basle, Switzerland. App. filed July 10, 1909. Pair of pressure members and yielding brackets.

1,120,813. ELECTRIC-RAILWAY SIGNALING DEVICE; F. S. Hart, Dayton, Ohio. App. filed Oct. 15, 1913. Signal for intersecting street corners.

1,120,829. CIRCUIT CONNECTION FOR ELECTRICAL APPARATUS; P. MacGahan, Pittsburgh, Pa. App. filed Oct. 18, 1905. Moisture-proof and dust-proof connection between coils and an external connection.

1,120,830. ELECTRIC WATER HEATER; John Mann, Kilburn, London, Eng. App. filed May 6, 1913. Heater wire wrapped about pipe coil which is sealed in vacuum chamber.

1,120,846. RELAY; H. A. Parrish, Kalamazoo, Mich. App. filed Dec. 17, 1913. Quickly and positively operated by a normally closed circuit.

1,120,849. MOISTURE-PROOFING AND MOISTURE-PROOFED TELEPHONE AND SWITCHBOARD CORD CONDUCTOR; A. Pruessman, Chicago, Ill. App. filed Feb. 16, 1912. Insulating compound saturates the fibrous covering to a depth less than the thickness thereof.

1,120,850. ELECTRICAL MEASURING INSTRUMENT; A. B. Reynders, Wilkinsburg, Pa. App. filed Sept. 6, 1910. Electrostatic type for measuring high potentials.

1,120,884. ELECTRICALLY HEATED CULINARY APPARATUS; J. I. Ayer, Cambridge, Mass. App. filed Dec. 2, 1912. Clamps on the stand hold the vessel in intimate contact with the heater.

1,120,949. CONTROLLING MEANS FOR VAPOR APPARATUS; P. C. Hewitt, New York, N. Y. App. filed Jan. 20, 1905. Strengthens the normal initial resistance to starting at a negative electrode.

1,120,951 MANUFACTURE OF INSULATORS FOR HIGH-POTENTIAL ELECTRIC CONDUCTORS; F. M. Locke, Victor, N. Y. App. filed March 9, 1909. Porcelain base and boron compound fused together to form a homogeneous body.

1,120,964. THERAPEUTIC APPARATUS; J. H. Neel, Los Angeles, Cal. App. filed June 3, 1913. Series of adjustable oppositely disposed magnets.

1,120,966. ELECTRIC HEAT RADIATOR; A. B. Neiman, New York, N. Y. App. filed Dec. 18, 1913. Resistance coil inclosed in flanged tube.

1,120,971. ELECTRIC SIGN; W. K. Queen and T. F. Pickett, Needham Heights, Mass. App. filed May 2, 1912. For indicating to the operatives in the boiler room the various changes in the load on the engines.

1,120,982. EXHIBITING DEVICE; H. D. Schroeder, Los Angeles, Cal. App. filed Sept. 29, 1913. Time of exhibition of each picture or advertisement controlled independently of speed operation of machine.

1,120,984. STATIC COLLECTING AND DISCHARGING MECHANISM; J. S. Thompson, Chicago, Ill. App. filed Feb. 9, 1912. Charges accumulated on printing press are discharged at intervals.

1,120,987. HEATING DEVICE; F. M. Vogel, Pittsfield, Mass. App. filed Feb. 12, 1912. Parts can be moved to vary the area of contact and flow of heat, as desired.

1,120,992. NEUTRALIZING INDUCTIVE DISTURBANCES; F. W. Alexanderson, Schenectady, N. Y. App. filed April 2, 1913. Alternating-current electric-railway system.

1,120,995. SIGNALING SYSTEM; C. E. Beach, Binghamton, N. Y. App. filed Jan. 23, 1914. Series circuit switching mechanism for fire-alarm system.

1,120,997. ELECTROMAGNETIC SELECTIVE DEVICE; W. S. Burnett, Milwaukee, Wis. App. filed Aug. 23, 1909. Applied to signal locking or unlocking mechanism.

1,121,014. ELECTRICAL APPARATUS; H. M. Hobart, Schenectady, N. Y. App. filed Jan. 23, 1914. Cools dynamo-electric machines by wetting the surface of the cores and then directing a current of air upon the wetted surface.

1,121,065. METHOD OF AND APPARATUS FOR PREVENTING SPARKING IN DYNAMO-ELECTRIC MACHINES; B. J. Boicourt, Colorado Springs, Col. App. filed Jan. 27, 1911. Ratio of interpole magnetomotive force is jumped up during abnormal loads.

1,121,067. ELECTRIC BELL; S. C. Bryant, Chicago, Ill. App. filed Aug. 27, 1913. Highway crossing bell.

1,121,074. ELECTRIC HEATER; H. W. Denhard, San Francisco, Cal. App. filed July 17, 1908. Positive and negative electrodes submerged in water.

1,121,077. ELECTRODE DEVICE FOR HIGH-FREQUENCY APPARATUS; W. Dubilier, Brooklyn, N. Y. App. filed Nov. 21, 1910. Rod electrode adjustably supported in a hollow casing electrode.

1,121,090. ELECTRIC DOOR OPENER; M. Guett, Hartford, Conn. App. filed Jan. 17, 1913. Unlocks the latch without opening the door.

1,121,104. COMBINATION HORN; J. W. Jones, New York, N. Y. App. filed Nov. 18, 1909. Electric horn combined with a reed horn.

1,121,121. APPARATUS FOR INDICATING A FAIR CHARGE FOR ELECTRICAL CURRENT CONSUMED; E. T. R. Murray, Radlett, Eng. App. filed Dec. 10, 1910. Instrument with special scale, a movable index and an interfering device thrown into operation when the maximum demand is exceeded.

1,121,124. ALARM SYSTEM; L. A. Northrup, San Francisco, Cal. App. filed Oct. 14, 1912. Burglar alarm which blows whistle and operates a light.

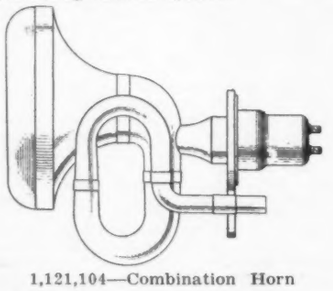
1,121,198. ANTISTATIC FRICTION DEVICE; J. J. O'Toole, New York, N. Y. App. filed Jan. 23, 1913. Has collecting fingers rotating above the bed of the printing press or the like.

1,121,242. ELECTRIC TABLE LAMP; R. S. Giese, Pittsburgh, Pa. App. filed April 8, 1914. Base, stem and shell made in a one-piece glass shell.

1,121,248. PORTABLE ELECTRIC-LIGHTING APPARATUS; H. H. Hirsch, Philadelphia, Pa. App. filed March 3, 1913. Miner's lamps with provision to prevent explosions.

1,121,249. PORTABLE ELECTRIC-LIGHTING APPARATUS; H. H. Hirsch, Philadelphia, Pa. App. filed March 3, 1913. Lamp is automatically extinguished when its casing is subjected to stresses tending to break it.

1,121,283. TRANSLATING DEVICE FOR RAILWAY SIGNALING; H. D. Patterson, Mount Vernon, N. Y. App. filed June 1, 1909. Alternating-current system.



1,121,104—Combination Horn

1,121,288. COMBINED PLUG, SWITCH AND FUSE; F. J. Ravlin, Chicago, Ill. App. filed Jan. 26, 1914. Weatherproof for outdoor hard service.

1,121,291. OUTLET OR SWITCH BOX; M. Robinson, Newton, Mass. App. filed July 22, 1911. Has special knockout construction.

1,121,292 ELECTRIC-LIGHT FLASHER; M. C. Ryan, Phoenix, N. Y. App. filed Jan. 27, 1910. Thermostatic switch mounted in the base of a lamp socket.

1,121,293. MAGNETIC LAMP SUPPORT; J. Sachs, Hartford, Conn. App. filed July 12, 1912. Flashlamp with magnet base.

1,121,329. ELECTRIC-LIGHT ATTACHMENT FOR LEVELS; P. E. Curtis, Bangor, Me. App. filed May 16, 1913. Inserted lamps throw light through the bubble tubes.

1,121,341. ELECTRIC RADIATOR HEATER; R. Farren, and C. T. Clark, Cleveland, Ohio. App. filed Sept. 17, 1914. Heating coil surrounds a pipe extending from the base to the top of the radiator.

1,121,347. SECONDARY ELECTRIC CLOCK; E. F. Geiger, Duluth, Minn. App. filed Jan. 31, 1914. Magnet and two-part propelling lever.

1,121,348. ELECTRIC-LAMP SOCKET; G. W. Goodridge, Bridgeport, Conn. App. filed Dec. 12, 1913. Shell-lock construction.

1,121,350. DISTRIBUTING BOX; W. B. Greene, East Cleveland, Ohio. App. filed March 6, 1914. Has interchangeable side plates of various designs.

1,121,356. TELEPHONE SYSTEM; J. Harrison, Glendale, Mo. App. filed July 29, 1910. High voltage is sent over the line to light a lamp which notifies person at a distance to respond to the call.

1,121,358. VAPOR-ELECTRIC TRANSLATING DEVICE; P. C. Hewitt, New York, N. Y. App. filed March 19, 1903. Has a divided gas or vapor path.

1,121,359. CONTROLLING MEANS FOR VAPOR APPARATUS; P. C. Hewitt, New York, N. Y. App. filed Jan. 20, 1905. Renders more difficult the starting of a current into an electrode which for the time being may be negative.

1,121,360. APPARATUS FOR TRANSFORMING ELECTRICAL ENERGY; P. C. Hewitt, New York, N. Y. App. filed Jan. 30, 1905. Produces intermittent or vibratory currents.

1,121,361. VAPOR-ELECTRIC APPARATUS; P. C. Hewitt, New York, N. Y. App. filed Feb. 4, 1903. Provision made for cooling and maintaining the proper purity and density of gas or vapor.

1,121,368. METALLIC-FILAMENT LAMP; H. J. Jaeger, Weehawken, N. J. App. filed Jan. 27, 1914. Has high and low candlepower filaments for use on automobiles.

1,121,374. CAP FOR LAMP SOCKETS, PENDENT SWITCHES AND OTHER ELECTRICAL DEVICES; C. J. Klein, Milwaukee, Wis. App. filed April 8, 1912. Cap lining retained in place by a yieldable member engaged beneath edge of the lining.

1,121,379. ELECTRICALLY PROPELLED VEHICLE; H. W. Leonard, Bronxville, N. Y. App. filed March 2, 1903. Prime mover drives generator which supplies the propelling motors. (Fifty-six claims).

1,121,380. ELECTRICALLY PROPELLED VEHICLE; H. W. Leonard, Bronxville, N. Y. App. filed March 2, 1903. Individual electric motor for each drive wheel.

1,121,381. ELECTRICALLY PROPELLED VEHICLE; H. W. Leonard, Bronxville, N. Y. App. filed March 2, 1903. Two drive motors to each drive wheel.

1,121,400. AUTOMATIC TELEPHONE CALLING DEVICE; P. Richardt, Prague, Austria-Hungary. App. filed Nov. 25, 1912. Ringing accomplished by merely taking receiver off the hook.

1,121,409. PROCESS FOR REMOVING LIQUID FROM ORGANIC AND INORGANIC SUBSTANCES; B. Schwerin, Frankfort-on-the-Main, Germany. App. filed April 6, 1914. Particularly for drying peat.

1,121,416. AUTOMATIC ELECTRIC GAS-DRIP ALARM DEVICE; C. H. Stevick, Astoria, N. Y. App. filed Jan. 23, 1914. Gives notice of collection of condensation water in a gas pipe or drip cup.

1,121,420. OPERATING MEANS FOR ELECTRIC-LAMP SWITCHES; A. J. Tigley, New York, N. Y. App. filed July 14, 1914. Has a rotary switch member.

1,121,424. SIGNALING APPARATUS FOR VEHICLES; W. M. Voss, Tampa, Fla. App. filed May 11, 1914. Automatic rear signal.

1,121,444. ELECTRIC WIRE CONDUIT FOR BUILDINGS; L. Adler, New York, N. Y. App. filed April 23, 1913. Made of sheet mental, elliptical in cross-section.

1,121,479. TRANSFORMER; E. L. Colby, Auburn, N. Y. App. filed Jan. 10, 1913. For wireless work; special arrangement of primary and secondary windings.

1,121,539. CIGAR LIGHTER FOR ATTACHMENT TO AUTOMOBILES AND THE LIKE; M. C. Schwab, Chicago, Ill. App. filed March 24, 1913. Attachable to the steering wheel.

1,121,540. ELECTRIC RECORDING INSTRUMENT; A. L. Sohn and C. L. Adams, Los Angeles, Cal. App. filed April 20, 1910. Employees' recording device.

1,121,544. CONTROL SYSTEM; N. Wilkinson, Milwaukee, Wis. App. filed Sept. 13, 1909. Uses resistance for a rheostat as a discharge resistance.

1,121,545. DYNAMO-ELECTRIC MACHINE; R. B. Williamson, Milwaukee, Wis. App. filed Oct. 5, 1908. Fastening for the stator coils.

1,121,561. ADVERTISING DEVICE; H. J. Keating, Chicago, Ill. App. filed June 28, 1912. Solenoids with air pistons controlling the movement.

1,121,562. SELECTIVE SIGNALING SYSTEM; O. T. Ladenan, Milwaukee, Wis. App. filed April 30, 1912. Of particular utility in connection with railroad lines.

1,121,567. MOTOR STARTER; A. C. McWilliams, Chicago, Ill. App. filed Feb. 19, 1912. For alternating-current motors.

1,121,574. CIRCUIT INTERRUPTER; C. Ralborg, Wilkinsburg, Pa. App. filed Oct. 7, 1908. For high-voltage alternating-current circuits.

1,121,575. CULINARY APPARATUS; T. Abtmeyer, Wilkinsburg, Pa. App. filed March 13, 1911. Frying-pan construction.

1,121,591. THERMOSTATIC VALVE; J. F. McElroy, Albany, N. Y. App. filed May 27, 1910. For steam-heating apparatus on a railway car.

1,121,593. ALARM MECHANISM FOR DISTRIBUTION SYSTEMS; James D. Nelson, Cincinnati, Ohio. App. filed Feb. 9, 1911. For automatic fire-extinguishing sprinklers.

13,849 (reissue). APPARATUS FOR MELTING AND MIXING METALS IN VACUO; W. S. Simpson, London, Eng. App. filed Sept. 16, 1913. Original patent No. 1,015,091, dated Jan. 16, 1912. Tilting crucible contained in vacuum chamber.

Electrical World

Volume 64, Number 26 McGraw Publishing Co., Inc. New York, December 26, 1914

Engineering Library

GENERAL LIBRARY
DEC 26 1914
UNIV. OF MICH.

OKONITE
Insulated Wires and Cables
defy Time
THE OKONITE COMPANY
253 BROADWAY, NEW YORK
Central Electric Company, Chicago, Ill., General Western Agents
F. D. Lawrence Elec. Co. Cincinnati, O.
Novelty Electric Co. Philadelphia, Pa.
Pettingell-Andrews Co. Boston, Mass.

OKONITE
TRADE MARK REG. U.S. PAT. OFF.
The STANDARD for Rubber Insulation

The New Weston PORTABLE Instrument Transformers

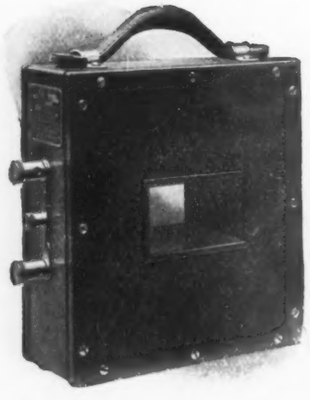
It is a fundamental of Weston policy that every instrument must be capable of accuracy far in excess of its guaranteed percentage. Instrument transformers—and especially the portable models—must necessarily be designed and made with a much greater degree of refinement than is necessary in commercial lighting and power transformers of which only ordinary accuracy is required.

Because it was not satisfied that any of the Instrument Transformers on the market had attained a really high standard of accuracy, the Weston Company has devoted several years of the most exhaustive analytical study and experimental investigation to the perfecting of Portable Instrument Transformers.

This work has involved the devising of new methods of measurement and the construction of special instruments to ascertain to the highest degree of precision the various factors which affect the performance of Instrument Transformers. The enormous amount of study and experiment has been amply justified by its wonderful result as represented in these new Weston Transformers. We can recommend them thoroughly. In every respect they maintain the exacting Weston standard of quality.

Weston Electrical Instrument Co., Newark, N. J.

New York	Boston	San Francisco	Buffalo	Montreal	Vancouver
Chicago	St. Louis	Detroit	Atlanta	Toronto	Berlin
Philadelphia	Denver	Cleveland	Richmond	Winnipeg	London



The full line of new Weston Portable Instrument Transformers, including the three illustrated here, is described in Bulletin 2001. *Bulletin* 1501 *contains a similar description of the new switchboard types.*

Electrical World

New York, December 26, 1914

Volume 64, No. 26

Pages 1229-1276

Contents

Electrical Equipment of Panama-Pacific Exposition 1241

Various Features of the Exterior and Interior Electric Distribution System—Extensive Use of Wooden Manholes and Conduit—Decorative and General Illumination.

Photometry of the Gas-Filled Lamp. By G. W. Middlekauff and J. F. Skogland 1248

An Analysis of the Causes for the Variation of Current and Candle-Power with Speed of Rotation.

Editorial

National Joint Line Committee 1229
Co-operation of Stockholders 1229
The Use of Statistics 1229
Co-operation in Foreign Trade 1229
Photometry of Gas-Filled Lamps 1230
Incandescent Search-Lanterns 1230
Electro-Dynamic Stresses 1231
Lighting of Country Roads 1231

News of the Week

Plans of the National Joint Committee on Line Construction 1232
Meeting of Oregon Electrical Contractors' Association 1232
Accident to Cleveland Distribution System 1232
Investments in Latin America 1232
Proposal for Texas Utilities Commission 1233
Urge Need of More Publicity Work for the Electric Truck 1233
Rate Agreement Reached at Houston, Tex 1233
Reply of Cincinnati Company to King Report 1233
Welfare Plans of Westinghouse Company 1233
Safety Medal to Commonwealth Edison Company 1234
Hearing on Muscle Shoals Project 1234
Central-Station Service for San Diego Exposition 1234
Stockholders in Cincinnati Rate Case 1234
Cheap Wiring Methods Discussed 1235
Mr. Britton on Water-Power Bill 1236
National Contractors' Association to Meet in San Francisco 1238
Public Service Commission News 1239
Current News Notes 1240

Digest of Current Electrical Literature 1259
Book Review 1261
New Apparatus and Appliances 1262
Jobber, Dealer and Contractor 1267
Industrial and Financial News 1268

Spark Discharges Between Unlike Metals 1247
Electrolytic Oxygen Manufactured in St. Louis 1247
Recent Telephone Patents 1256

Central Station Management

Advertising the Low Cost of Electric Service 1252
The Physician's Electric Phaeton 1252
Two Hundred Houses Wired in Sixty Days 1252
Electrically Heated Water for Beef Importer 1252
Savings Through Electric-Vehicle Operation at Wichita, Kan. 1253
Showing Up the Friction-Load Losses 1253
Pointed Paragraphs on Public Policy 1254

Illumination and Wiring

Conduit Wiring on Plaster-Board Partitions. By G. M. Durfee 1254
Illumination of Motion-Picture Theater Entrance 1255
Trainman's Storage-Battery Lamp 1255

Letter to the Editors

Sulphur as a Conductor. By Chester A. Butman 1256

Field of the Operating Engineer

Accident Caused by Mouse in Oil Switch 1257
Illumination of Switchboards 1257
Safeguarding Employees Around Series Lighting Circuits 1257
Water Softening by Electrochemical Methods 1257
Combined Telephone and Telegraph Circuit for Operating Water-Power System 1258
Circuit-Breaker Location for Parallel Operation 1258

Corporate and Financial 1269
Business Notes 1271
Personal Mention 1272
Construction News 1273
Patent Record 1275

JAMES H. MCGRAW, President. J. T. DEMOTT, Treasurer. A. S. MCALLISTER, Editor.

McGraw Publishing Company, Inc.

CHICAGO, 1570 Old Colony Bldg.
PHILADELPHIA, Real Estate Trust Bldg.
239 West 39th St., New York City
SAN FRANCISCO, 502 Rialto Bldg.
LONDON, 10 Norfolk St., Strand.

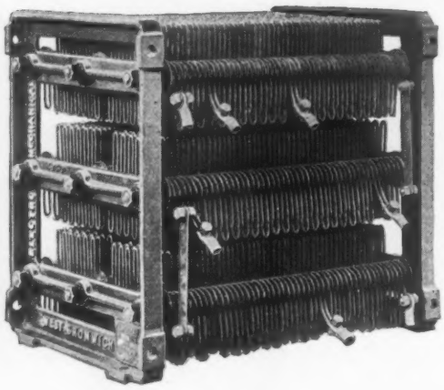
COPYRIGHT, 1914, by MCGRAW PUBLISHING COMPANY, Inc. Published Weekly. Entered at N. Y. Post Office as Second Class Mail. United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, $3 per year; Canada, $4.50; elsewhere, $6. Single copy, 10c.

No back volumes for more than one year and no back copies for more than three months.

Circulation of this issue, 19,500 copies

ELECTRICAL WORLD—MEMBER SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.—"DO IT ELECTRICALLY"

For Cranes, Hoisting, Steel Mill and Other Severe Duty Machinery



where the electric equipment is often more or less exposed to the attacks and deteriorating influences of dampness and temperature extremes as well as to the wear and tear of heavy starting loads applied to the **control apparatus.**

EMB

Unbreakable Rustproof Resistances

eliminate the weak spot common to ordinary controls used in such service. No dampness can corrode EMB. Neither can the rush of current find and fuse a weak spot as in imperfect cast grids, because EMB grids are of **uniform** thickness from end to end. And they're **jointless,** too—no joints to heat up in an EMB grid—no intermittent contacts—no arcing. No, when the tons of load are dragged from rest by the leaping current EMB Resistances **carry the load** safely and surely. And hard knocks won't break them either, because they're not brittle.

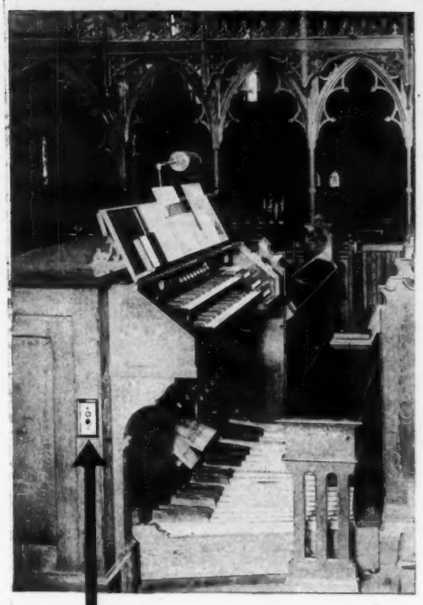
Send us electrical data and details of your service for Trial Equipment.

THE ELLCON COMPANY

50 Church Street, New York

71835

CUTLER-HAMMER



"Pushing the Button" starts the motor-driven blower in the basement.

And starts it right every time, without the necessity of going to the basement.

Before beginning to play, the organist pushes the button of the switch and the blower is started. There is no delay, no misunderstanding,—no trouble. He has complete control.

Hundreds of other motor-driven machines can be automatically controlled in this way. No matter who pushes the button or closes the switch—the motor is accelerated properly every time.

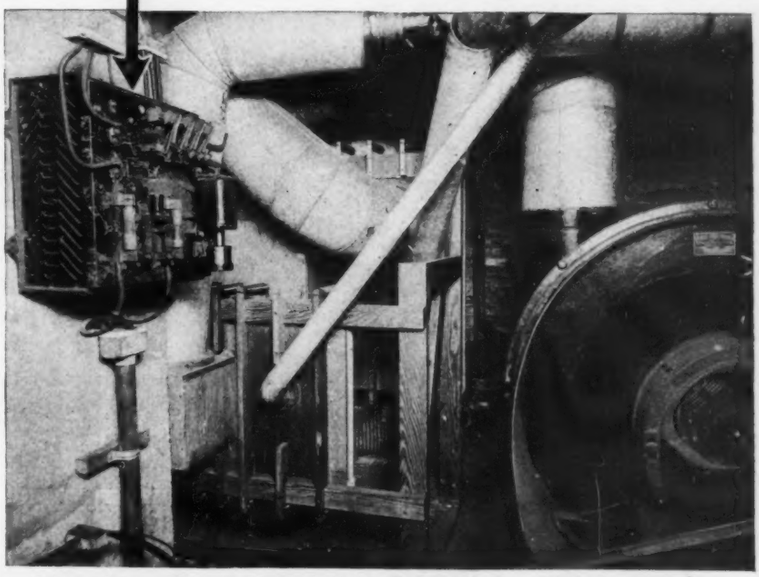
CUTLER-HAMMER Automatic Motor Starters

save current, reduce maintenance costs, insure against accidents and improve results.

They provide means for the automatic or remote control of pumps, vacuum cleaners, compressors, blowers and many classes of motor-driven machines. The most inexperienced laborer can start and stop the motor at will as correctly as the most experienced electrician.

Ask for Automatic Motor Starter Booklet

Current limiting type self-starters are furnished where dash-pot type acceleration is not best adapted.



Motor-driven Blower Controlled by Cutler-Hammer Bulletin 6100 Automatic Starter. Control Switch Convenient for Organist

THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: 50 Church Street CHICAGO: Peoples Gas Bldg. PITTSBURG: Farmers' Bank Bldg. BOSTON: Columbian Life Bldg.
PHILADELPHIA: 1201 Chestnut Street CLEVELAND: Schofield Building CINCINNATI: Gwynne Building
PACIFIC COAST AGENTS: H. B. Squires Co., 579 Howard St., SAN FRANCISCO. San Fernando Bldg., LOS ANGELES and Morgan Building, PORTLAND, ORE.

Western Electric
Power Apparatus
For Every Need
SEND TO OUR NEAREST HOUSE
FOR BULLETIN
"SAVE TIME AND FREIGHT"
DYNAMOS-MOTORS
WESTERN ELECTRIC
COMPANY
CABLES-TELEPHONES-SUPPLIES
"TELEPHONE OUR NEAREST HOUSE"
Western Electric Company
Manufacturers of the 8,000,000 "Bell" Telephones
New York Atlanta Chicago Kansas City San Francisco Montreal London
Buffalo Richmond Milwaukee Omaha Oakland Toronto Paris
Philadelphia Savannah Indianapolis Oklahoma City Los Angeles Winnipeg Berlin
Boston New Orleans Detroit Denver Salt Lake City Calgary Antwerp
Pittsburgh Houston Cincinnati Minneapolis Seattle Vancouver Milan
Cleveland Dallas St Louis St Paul Portland Edmonton Rome
Johannesburg Sidney St Petersburg Vienna Buenos Ayres Tokyo
EQUIPMENT FOR EVERY ELECTRICAL NEED
"MEMBER OF"
SERVICE
SOCIETY FOR ELECTRICAL DEVELOPMENT INC
SAFETY
"DO IT ELECTRICALLY"

SAFETY
Steel Taped Cable

It is one thing to state—in the light of actual cost comparisons in actual work—that SAFETY Steel Taped Cable will show a saving running as high as 50 per cent over a duct or conduit system. It is another thing to be able to state—also in the light of actual experience—that a SAFETY Cable system has all the merit of a duct or conduit system. Too often, a mere saving in cost is realized only at a sacrifice of some other valuable feature. Not so with SAFETY Steel Taped Cable —its use demands no compromises. While it would be foolish to say that the great city conduit systems could be dispensed with by using SAFETY Cable, neverthless it can be proved in hard, cold figures that for small towns and cities, park and boulevard illumination, and other service which would otherwise require a line of underground conduits, SAFETY Steel Taped Cable has every advantage in its favor—both as a matter of finance and as a matter of engineering.

Write for Bulletin 200B.

SAFETY INSULATED WIRE & CABLE CO.
114 Liberty Street, NEW YORK
CHICAGO BOSTON
ATLANTA SAN FRANCISCO

No. SIW-101

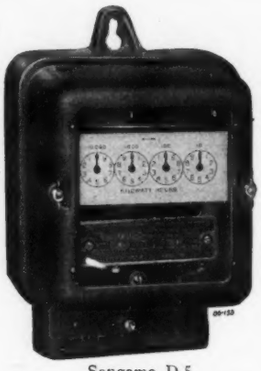
The World's Greatest Central Stations

are equipped with

SANGAMO
BUILT LIKE A WATCH

Watthour Meters

Sangamo D-5
switchboard type watthour meter



Sangamo D-5
service type watthour meter

They have been installed by the world's largest Central Stations because:

Sangamo Meters—A.C. or D.C.—**stand short circuits to meet the most severe requirements of the meter code of the Edison Illuminating Companies.**

Guaranteed accurate **within 2 per cent.,** from 5 per cent. of full load to 150 per cent. overload. Operate accurately **when levelled by eye.** All 10 ampere D.C. meters have 100 per cent. continuous overload capacity. Other meters, A.C. and D.C., guaranteed for 50 per cent. continuous overload.

Get full details from our nearest office or agent

New York Office, 50 Church St. **Rochester Office, 75 Exchange St.**

AGENTS

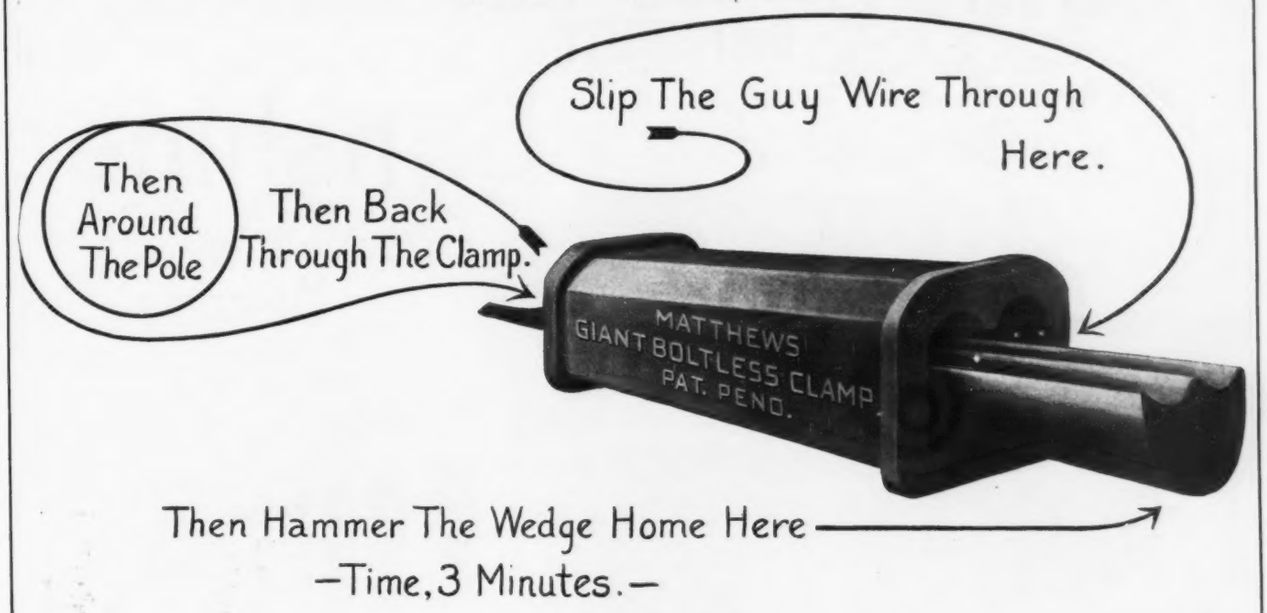
Electric Appliance Co.	Chicago	701 W. Jackson Blvd.	Federal Sign System (Electric)	Chicago	Lake & Desplaines Sts.
Electric Appliance Co.	New Orleans	408 Canal St.	Federal Sign System (Electric)	New York	1790 Broadway
Electric Appliance Co.	Dallas	1111 Jackson St.	Federal Sign System (Electric)	San Francisco	171 Second Street
Electric Appliance Co.	San Francisco	807 Mission St.	Chas. F. Saenger & Company	Cleveland	Electric Building
Ludwig Hommel & Company	Pittsburgh	422 First Ave.	J. F. Schaefer & Company	Kansas City	618 Dwight Building
Wetmore-Savage Company	Boston	76 Pearl St.	Mountain Electric Company	Denver	1619 Glenarm St.
Rumsey Electric Company	Philadelphia	1231 Arch St.	J. I. Linler	Spartansburg, S.C.	

Sangamo Electric Company
Springfield, Illinois

Sangamo Electric Co. of Can., Ltd. Montreal, 160 St. James St., Toronto, 1221 Traders' Bank Bldg.
Moloney Electric Co. of Can., Ltd.: Toronto, 1401 Traders' Bank Bldg. Northern Electric Co., Ltd.: Montreal, 822 Notre Dame St., W.
EUROPEAN REPRESENTATIVE: John F. Monnot, c/o Edison Accumulators, Ltd., 2 & 3 Duke St., London, S. W.
J. F. Monnot, Paris, France, 31 Rue Daru. Manila, P. I., J. F. Stevenot.

HOW A SLOGAN WAS SUGGESTED

By Claude L. Matthews


Slip The Guy Wire Through Here.
Then Around The Pole
Then Back Through The Clamp.
MATTHEWS GIANT BOLTLESS CLAMP PAT. PEND.
Then Hammer The Wedge Home Here
—Time, 3 Minutes.—

It was in April, 1913, in the Laboratory of Applied Mechanics of the University of Illinois at Champaign, Ill. We were making some tests on the holding power of various guy clamps—Professor Moore, two senior engineering students and I. I was there in the interest of Matthews Boltless Guy Clamps.

Some of the story will be omitted for the sake of brevity. The result of two typical tests will be given. The machine was the well-known Riehle Testing Machine, capacity 50,000 pounds.

TEST No. 1

Matthews Baby Boltless Guy Clamp. Strand used 5/16 inch Siemens-Martin. One wrap around 6 inch cast-iron pipe.

Load	Slip	Load	Slip
1,000 pounds....	.0 inch	4,500 pounds...	.229 inch
1,500 pounds....	.005 inch	5,000 pounds...	.436 inch
1,950 pounds....	.010 inch	5,500 pounds...	.678 inch
2,500 pounds....	.018 inch	6,000 pounds...	1.125 inches
3,000 pounds....	.028 inch	6,200 pounds...	1.684 inches
3,500 pounds....	.040 inch	6,500 pounds...	2.000 inches
4,000 pounds....	.074 inch	6,820 pounds...	Broke

TEST No. 2

Matthews Giant Boltless Guy Clamp. Strand used ⅜ inch Siemens-Martin. (This strand should have held 10,000 pounds or more, but of several samples tested it did not come up to guarantee.) One wrap around 6 inch cast-iron pipe.

Load	Slip	Load	Slip
1,000 pounds....	.0 inch	5,000 pounds....	.048 inch
1,500 pounds....	.0 inch	5,500 pounds....	.048 inch
2,000 pounds....	.0 inch	6,000 pounds....	.053 inch
2,500 pounds....	.0 inch	6,500 pounds....	.063 inch
3,000 pounds....	.0 inch	7,000 pounds....	.077 inch
3,500 pounds....	.029 inch	7,500 pounds....	.110 inch
4,000 pounds....	.033 inch	8,000 pounds....	.236 inch
4,500 pounds....	.048 inch	8,320 pounds....	Broke

"THE WAY THEY WEDGE IS A SAFETY PLEDGE"

If a wooden pole had been used and if the loose end of the guy strand had been served to the through strand in accordance with the general practice, the slip would not have been noticeable.

It will be noted that in Test No. 1 there was only 74/1000 of an inch slip up to 4,500 pounds. Then the strand began to lessen in diameter and the slip became more pronounced as the strain was increased. The wedge followed into the sleeve as the strand decreased in diameter and took up the strain. From 5,500 pounds to 6,820 the slip was much more pronounced. This was because the lessening of the diameter was more rapid due to the elongation of the strand just before it broke. If the strain had been eased off anywhere below 6,800 pounds, the guy strand would not have broken and the clamp would have held the strain.

In all tests of the ordinary 3-bolt clamps, as soon as the strain reached 5,000 to 5,500 pounds, the strand started to slip through and continued to do so as long as the strain remained between these points.

In Test No. 2 it will be noted that the clamp held with practically no slip at all up to the breaking point of the strand—only 236/1000 of an inch. The fact that Matthews Boltless Clamps do not permit the strand to continue to slip, but automatically compensate for the lessened diameter, caused someone to say:

"THE WAY THEY WEDGE IS A SAFETY PLEDGE"

And that has been our slogan for them ever since.

You can't expect to have a man at each 3-bolt clamp when severe wind storms put more than 5,000 pounds strain on them. If you don't they will slip. Matthews Boltless Guy Clamps can be absolutely depended upon for 5,000 pounds (Baby) and 8,000 pounds (Giant).

If your strains are going to be greater than 8,000 pounds, use Matthews 2-Bolt Guy Clamp. It is good for 16,000 pounds.

YOU CAN TRY ANY NUMBER OF THEM FOR 30 DAYS AT OUR RISK—HOW MANY?

W. N. MATTHEWS, PRESIDENT AND TREASURER.

CLAUDE L. MATTHEWS VICE-PRESIDENT AND SECRETARY

W. N. MATTHEWS & BROTHER

INCORPORATED.

Manufacturers of Patented Money Saving Specialties

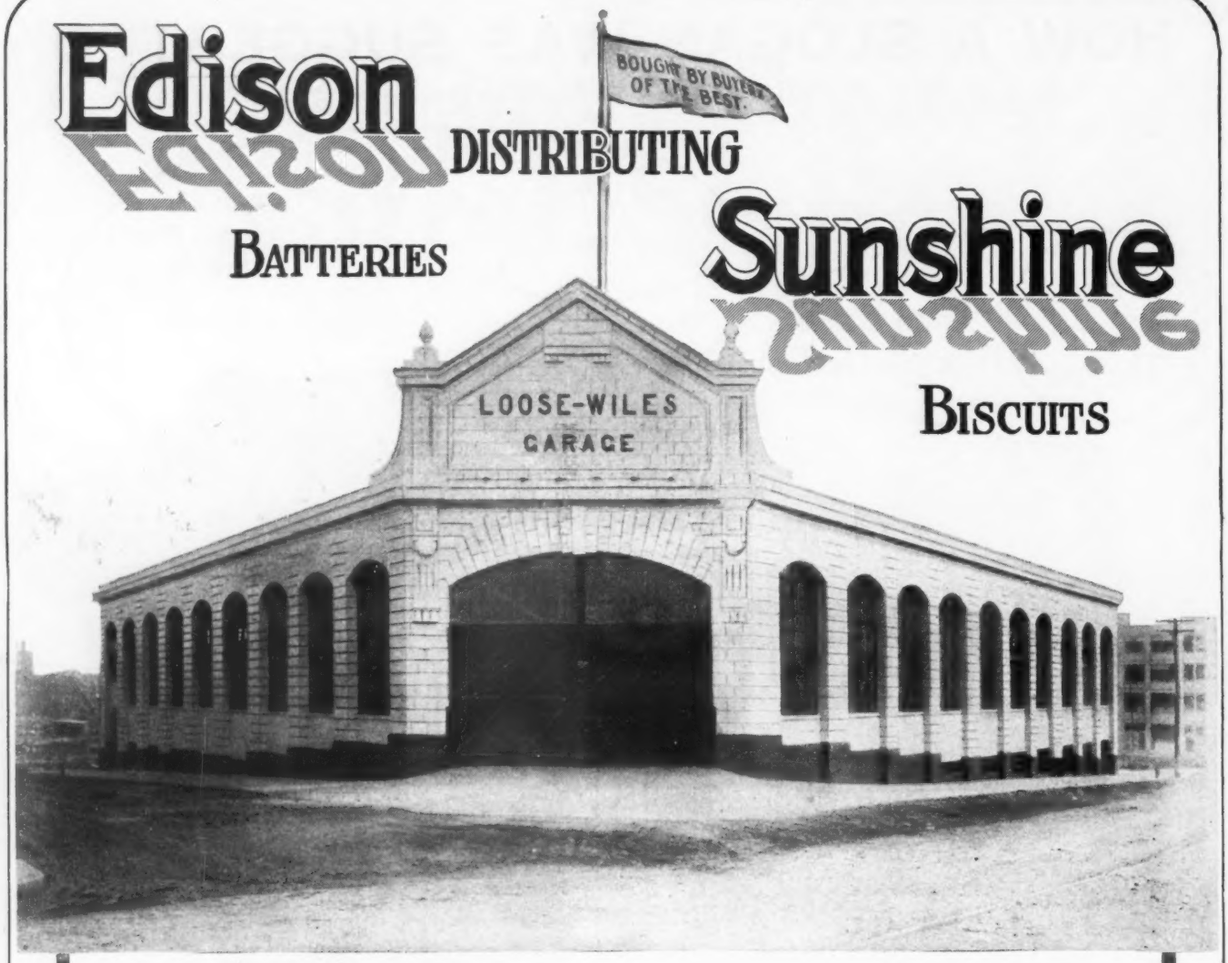
ST. LOUIS, U. S. A.

DISTRICT OFFICES
NEW YORK
CHICAGO
SAN FRANCISCO

FACTORIES
ST. LOUIS, MO.
SIDNEY, OHIO
ROCKFORD, ILL.

Canadian Distributors
Northern Electric Company, Limited
Montreal, Halifax, Toronto, Winnipeg, Regina, Calgary, Edmonton, Vancouver, Victoria

Edison DISTRIBUTING BATTERIES Sunshine BISCUITS



The Proof of the Pudding

The Loose-Wiles Biscuit Co., Long Island City, operates twenty-eight (28) Electric Trucks and Delivery Wagons, all equipped with

Edison Nickel-Iron Storage Batteries

This Company has recently ordered fifteen (15) more. *Edison Batteries are specified for every one,* making the Electric Fleet Exclusively Edison.

"Repeated Purchase by Conservative and Successful Concerns is Undeniable Proof of Merit."

General Vehicle

EDISON STORAGE BATTERY COMPANY

Orange, New Jersey

Distributors in
New York, Chicago, Boston, Cleveland, Washington, San Francisco, Los Angeles, Portland, Ore., Seattle

General Motors

Have you ever stopped to consider:

SOME BELT DRIVES are more efficient and wear better than others.

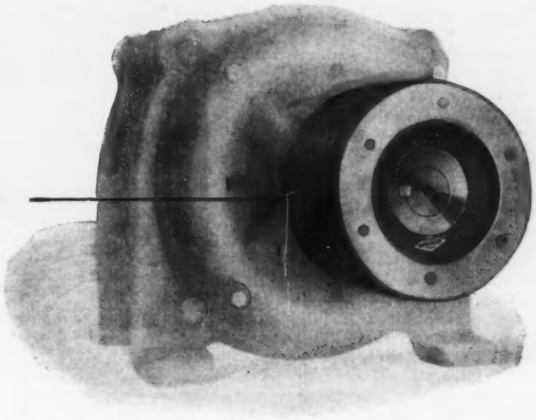
THE PULLEY on which the belt takes best "grip" is the pulley for lowest slip and maximum belt wear.

HIGH BELT SLIP is a direct loss of power. Furthermore it generates heat which dries out the belt, robbing it of strength and vitality. Such belts wear poorly.

THERE IS ONE KIND OF PULLEY THAT INSURES LOWEST SLIP AND MAXIMUM BELT WEAR.

The Rockwood Paper Pulley

"A Perfect Pulley for Belt Drives"



ITS SUPERIORITY over other kinds of pulleys is real and the difference is worth while.

BACK OF EVERY ROCKWOOD PAPER PULLEY is over twenty-five years of continued satisfactory service.

TO-DAY it is the accepted standard for motor and generator belt drives.

THINK IT OVER—THEN WRITE

The proof is yours for the asking.

THE ROCKWOOD MANUFACTURING COMPANY

Indianapolis, Indiana, U. S. A.

Marking a Light for your Children's Children

Talks about MAZDA Number 7

SCORES of curious symbols that have come down to us from antiquity prove that trade-marks are not a modern institution. Our museums are rich in the marks of Greek and Roman craftsmen, of medieval merchants and masters, of early printers. Trade marks are found on ancient loaves of bread dug up in buried Pompeii, on eye salves compounded by Roman oculists, and exported to the ancient civilized world, on the vessels, bronzes, weapons and utensils of antiquity, on the wares of medieval merchants.

Marks found on a rat-tail spoon made at Edinburg in 1749

What do they denote—these strange signs of a time when only a few scholars could read and write? An illiterate gentlemen of the olden times saw the private mark of John Smith on a sword blade or of Thomas Woolson on a glove. Forthwith he knew who made the sword or the glove, and accepted them as a good sword blade and a good glove.

What did "good" mean to him? Just this: The sword blade or glove was equal in quality to the sword blades and gloves that his grand-father had bought before him. *Uniformity of quality* was the chief concern of the ancient and medieval purchaser, and a trade-mark was to him chiefly a guarantee that *the old quality had been maintained*.

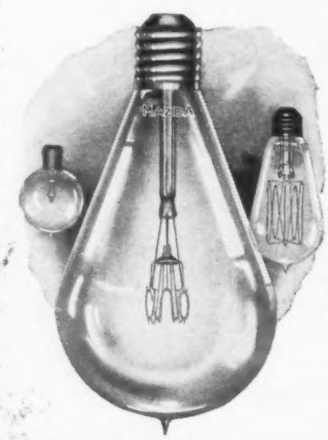
The old spirit is not dead. Uniformity of product, year in and year out, is guaranteed by many trade-marks of today; they are akin to the marks of old, chiefly because the wares to which they are affixed are not capable of much improvement.

But *industrially* the world would stand still—as it stood still for a time in the Middle Ages—if to us a trade-mark meant merely: "This book, this piece of cloth, this iron pot, is no worse than the book, the cloth, the iron pot of my grandfather; therefore I will buy it." Because wares are now made better and better as the years go by, some modern trade-marks are guarantees not only that an old standard has been maintained, but that it has even been surpassed. *Constant improvement* not merely *uniformity of quality* is the ideal. A still newer ideal of progress is expressed in the word MAZDA, etched on the newest incandescent lamps.

The trade mark used by a Hanseatic ship-builder about 1727.

Picture the amazement of a medieval merchant if the meaning of MAZDA could be explained to him. What would he say if he were told not only that MAZDA is a mark applied to a lamp far more efficient than anything which preceded it, but also that it will inevitably be applied to lamps, which are in process of development now—lamps which we ourselves may never see and which our children and grand-children will utilize? What would he say if he were told that this constant improvement of the electric incandescent lamp is the deliberate business of the whole world's scientific experts on illumination?

Year by year electrical incandescent lighting is becoming better and cheaper for the reason that MAZDA lamps are being constantly improved. It takes the keenest scientific brains of the time to evolve new lamps from lamps that are not yet old, and when the task is for the moment accomplished, the result is invariably a lamp marked MAZDA. That is why the MAZDA lamp of today gives three to six times as much light for the same current consumption as the carbon filament lamp of yesterday. The lamp of the future will be still more efficient, and it, too, will be marked MAZDA.



Unlike the marks of the ancient manufacturers and merchants—and most of those of our own time—which guarantee the *continuance of former quality*, the mark MAZDA, on these lamps is to indicate *ever-improving quality* and achievement. For it is not the name of one maker's lamps, but the mark of a Service—a guarantee to you that any maker of a lamp so marked, has received the results of the ceaseless investigations being made by MAZDA Service, and so has been able to embody in this lamp, marked "MAZDA" the latest discoveries of the world's ablest lighting experts.

That MAZDA lamps may be thus constantly improved the General Electric Company maintains wonderfully equipped Research Laboratories at Schenectady, New York, where the foremost illumination experts of our time experiment and test, year in and year out, in the effort to better filaments, to produce an illuminant that will outshine anything the world has ever known. These experts are in communication with chemists and physicists working in the same field in other parts of the world. Hence a MAZDA lamp is always the product of the best scientific thought of the time.

This is the mark of a furniture maker of Braunsweig, dating back to 1727

The result of this expert work is communicated by the General Electric Company to its lamp manufacturing centers at Cleveland and Harrison and to other lamp manufacturing companies entitled to learn of it.

This important research and the communication of important developments constitute MAZDA Service. Since all these manufacturers make MAZDA lamps, the word is not so much the name of a product as the mark of the MAZDA Service which progressively increases the efficiency of the product. When you see the mark MAZDA think of the endless experiments made before the lamp was produced; think of the research conducted in a dozen scientific fields in the ceaseless effort to attain the perfect light; think of the MAZDA Service, which inspires this ceaseless investigation and communicates the results to the makers of MAZDA lamps.

The mark of William Caxton, the most famous of the early English printers.

Clearly this word MAZDA is a kind of trade-mark not only different from anything known in the olden days, but something new even in our own day. It symbolizes a higher kind of service than that of supplying merely a product as good as the old. It is not only a guarantee of excellence, but a guarantee that the lamp to which it is affixed is at the time the supreme effort of the world's foremost experts in illumination.

GENERAL ELECTRIC COMPANY

MAZDA

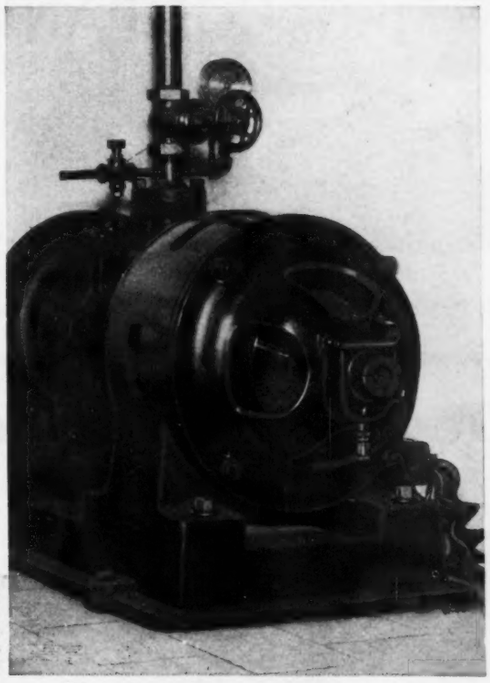
"Not the name of a thing but the mark of a Service"

4608

A Distinct Achievement

was the production of the

Wagner Starterless Polyphase Motor



Centrifugal pump operated by a five-horse power Wagner Self-starting Polyphase Motor. In this instance the simplicity of control is particularly advantageous, the motor being started and stopped by a single-throw switch actuated by a float.

A motor that has high starting torque, with characteristics of the squirrel cage motor, when it has attained full speed.

It is remarkably well adapted to automatic or remote control service. The closing of a switch is all that is necessary for starting. This can be accomplished by a very simple relay and solenoid.

Bulletin 1024.

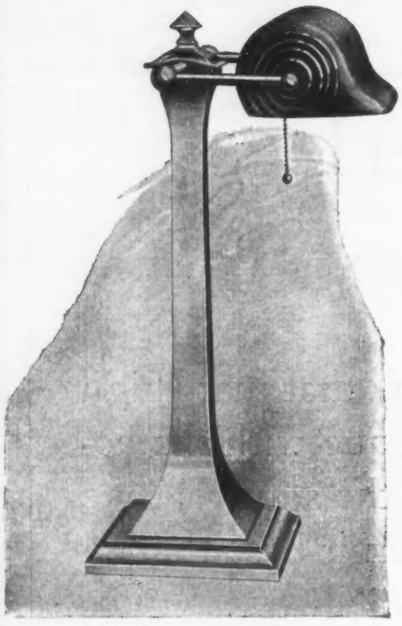
Wagner Electric

Manufacturing Company, St. Louis, Mo.

Member Society for Electrical Development. Do it Electrically.

91

The New Verdelite Shade



No. 3244 Verdelite

The latest thing in Green Glass Shade on the market. We have discontinued the old style Sheffield shade on all portables and brackets shown in Number 22 catalog, booklets, circulars and jobbers' catalogs, and now furnish the plain shade only as shown above on all portables and brackets with green glass shades.

Prepare for the Holidays by ordering a stock NOW. If you want the latest, order THE VERDELITE LINE.

Get our new circular

FARIES MFG. COMPANY

1036 East Grand Ave. DECATUR, ILL.

No. 3068 Verdelite

The L & N Dial Decade Portable Testing Set Type S

A New Design with Radical Improvements—Small—Accurate—Inexpensive

Here is the story in brief:—

Size—7⅜" x 8¾" x 4½".

Weight—8 pounds.

Switches—Dial Type. No plugs are used. Contacts are all underneath the rubber plate and thus protected from dust and dirt, but are readily accessible for inspection.

Accuracy—1/10% in Rheostat, 1/20% in Ratio.

Galvanometer—Our new interchangeable type. Sensitivity 1 megohm.

Directions—Complete directions for making resistance measurements and the loop tests for locating faults in lines and cables accompanying each instrument.

Guarantee—Fully protects the purchaser against defects in material or workmanship.

Price, $60

Bulletin No. 530 goes more into detail. Let us send you a copy.

The Leeds & Northrup Co.

Electrical Measuring Instruments

4903 Stenton Avenue, Philadelphia

"Circle T" Armored Cable

Send for a sample of it and loop it up this way yourself. Find out how much time it will save on installations, for your men to place a cable they can bend quickly to sharp turns without danger of damage. Flexible, strong, doesn't unwind when cut. Can be used with standard fittings.

The big demand for it is fast growing.

Write for a sample.

The Trumbull Electric Mfg. Co.
Plainville, Conn.

New York Boston Philadelphia Chicago San Francisco

9516

Cut Down Your Time-Sheet and Pay Roll

By Installing

"Diamond H" Switches and Receptacles

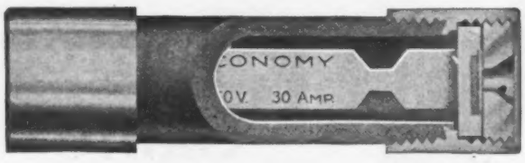
You don't have to bother with temporary plates when installing **"Diamond H"** Switches and Receptacles. And **"Diamond H"** binding posts render "hooking up" these switches and receptacles a quick and easy job. These features save contractors time and money. Design and construction render **"Diamond H"** switches and receptacles dust-proof and dirt-proof. A special **"Diamond H"** mechanism closes the holes in **"Diamond H"** receptacles when the plug is removed. The **"Diamond H"** line is fully guaranteed and their satisfactory service is assured. The failure of switches or receptacles reflects discredit on the contractor installing them, even though it be not his fault. That's why many contractors demand **"Diamond H."** They know they are fully protected by the guarantee of the makers.

Dealers should be prepared to meet this demand.

The **"Diamond H"** catalog shows over 70 types—write for it.

THE HART MFG. COMPANY, Hartford, Conn.

New York Boston Chicago Pittsburg San Francisco Denver Toronto London, Eng.



"Look for the Gray Shell"

$20,000

worth (in round numbers)

of

ECONOMY

renewable cartridge

FUSES

have been used by one great industrial plant. Rigid comparative tests proved Economy renewable cartridge Fuses to show the greatest saving at a consistent factor of safety.

In a few seconds, and a trifling expense, a blown fuse is renewed by inserting an Economy "Drop-Out" Link. Figures covering the space of a year will prove a saving over the use of old style non-renewable fuses amounting to a full eighty per cent.

Write today asking for Catalog No. 27A and free samples

Economy Fuse & Mfg. Co.
Kinzie and Orleans Sts.
Chicago

Economy Fuse & Mfg. Co.,
Kinzie and Orleans Sts., Chicago

Please send Catalog No. 27A, list of users, and sample fuses for.....amps, ...volts

.....

.....

.....

"SHERARDUCT"

Sherardized Rigid Steel Conduit

is made of the highest grade Spellerized steel tubing, manufactured exclusively by the National Tube Company.

Sherarduct is made of tubing thoroughly pickled, cleaned, scoured and freed from scale before being treated.

Sherarduct is SHERARDIZED,—a treatment in which zinc is alloyed with the steel of *both interior and exterior surfaces* in such a manner as to make them not only absolutely rust proof, but also more resistant to mechanical injury than is possible where the zinc is merely applied to the surface, and to the outer surface only, as in other zinc protective treatments.

Sherarduct is so thoroughly annealed during the gradual heating and cooling of the Sherardizing process that it is more easy to cut, thread and bend than other conduits.

Sherarduct is coated,—both *inner* and *outer* surfaces,—with several coatings of a clear, transparent, acid and alkali proof enamel, baked on. This is an exclusive feature, and of particular value, especially where the conduit is used in cinders or cinder fill concrete, round houses, or other places where the zinc surfaces would be exposed to the destructive action of sulphurous acids.

Sherarduct has threads which are sharp, clean, true and *uniformly* protected, a result which cannot be attained through other zinc protective treatments.

Sherarduct is a superior conduit in every way, and is manufactured exclusively by

National Metal Molding Co.
Manufacturers of Electrical Conduits and Fittings
1105 Fulton Building, Pittsburgh, Pa.

Boston	New York	Chicago
Atlanta	Denver	San Francisco
Los Angeles	Portland	Seattle
Buffalo		Detroit

Saks & Co.
New York City.

Increase Your Profits And Patronage

Frink and J-M Linolite Systems of Lighting have been installed in 30,000 stores, 25,000 churches and numberless other buildings.

Are you getting your share of this business?

The reputation enjoyed by the

Frink and J-M Linolite Systems of Lighting

and the wide advertising given them, make it probable that some store, church or other building in your town is considering, right at this moment, the installation of this superior form of illumination. *You* should be getting this business.

Increase your profits and bring new customers to your store by handling Frink and J-M Linolite Systems of Lighting. A beautiful light—soft and mellow—the nearest approach to perfection in illumination.

Let us tell you more about how you can cash in on the demand created for this form of illumination by our advertising. Write nearest Branch for latest Frink and J-M Linolite Catalog.

H. W. JOHNS-MANVILLE CO.

SOLE SELLING AGENTS FOR FRINK PRODUCTS.

Manufacturers of Service, Subway and Transformer Boxes; Fuses; Line Material; Insulating Materials; Fibre Conduit; Fireproof Wood; Friction Tapes; Dry Batteries; Etc.

Atlanta	Cincinnati	Galveston	Memphis	New York	St. Louis
Baltimore	Cleveland	Indianapolis	Milwaukee	Omaha	Salt Lake City
Boston	Columbus	Kansas City	Minneapolis	Philadelphia	San Francisco
Buffalo	Denver	Los Angeles	Newark	Pittsburgh	Seattle
Chicago	Detroit	Louisville	New Orleans	Portland	Toledo

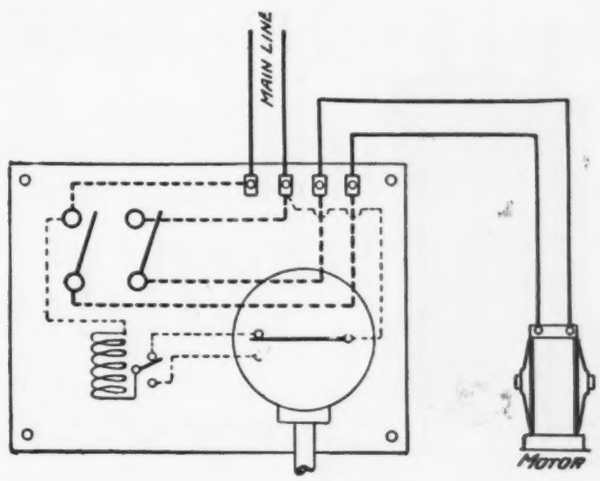
THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED. Toronto Montreal Winnipeg Vancouver

For Great Britain and Continent of Europe:
TURNERS & MANVILLE, LTD., Hopetoun House, 5, Lloyds Ave., London, E. C.

Member of the Society for Electrical Development, Inc. "DO IT ELECTRICALLY"

2929

This Diagram Shows How Simple It Is



to wire up a Sundh Pressure Regulator for starting a small motor without the use of a starting resistance.

The double pole type of Pressure Regulator is shown, but in many cases of Direct Current and single-phase Alternating Current, a single pole type can be used. It may be also adapted for starting A. C. Motors of two or three phases, three wire, or two phases, four wire when it is permissible to open two circuits and to run the neutrals direct to the motor.

The Sundh Catalog contains detailed information. Shall we send it?

SUNDH ELECTRIC COMPANY

NEW YORK, U.S.A.

Chicago Office, H. J. Kaufman, People's Gas Building

2

Attractive on the Shelf
A Booster in Service

The fine finish and handsome appearance of the "Jove" Battery Lanterns renders them very effective for show window or shelf display purposes. Their attractiveness alone rapidly makes initial sales and once you sell a few

"Jove" Battery Lanterns

their superior convenience and efficiency in service will rapidly create a constantly growing demand. The "Jove" Battery Lantern takes any No. 6 dry cell—throws a brilliant light 200 feet—is absolutely foolproof—and costs less than inferior articles. Get quotations.

Made in three finishes—black, brass and nickel.

Ask your jobber

Merchant Engineers Corporation
30 Church Street, New York

71701-P

Type "TR"
Three-Phase.

THE INCREASING IMPORTANCE

of local loads of small amount, distributed along medium voltage transmission lines, leads the Moloney Company to offer—

Moloney
"Satisfaction"
TRANSFORMERS

Type "HP"
Single-Phase

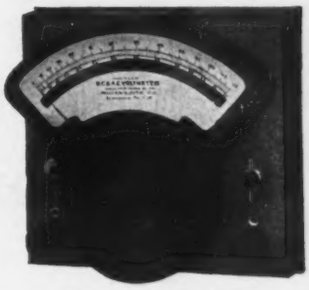
for such service—bearing in mind the service conditions—outdoors, practically no attention, etc.

Wide-awake managers will investigate these transformers.

Moloney Electric Company
St. Louis, Mo. **Windsor, Ont.**

"STOP, LOOK and LISTEN"

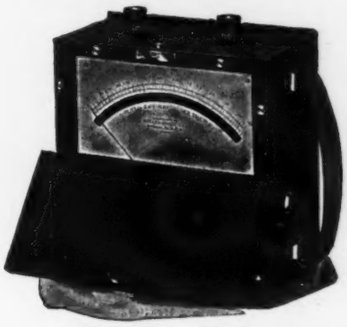
is a warning that is directed not only to the man who is about to cross a railroad track, but to the man who is about to buy alternating current instruments. In the entire field of electrical apparatus there is no device in the manufacture of which extensive experience and superior engineering ability count for some much as in these same A. C. instruments. There are some good ones on the market and there are some which could not, by the wildest stretch of the imagination, be called good.



"Portable Standard" Type.

"Torsion" Type.

The high esteem in which Roller-Smith Portable A. C. Instruments are held is proof that we have profited by our twenty years' experience in the game. All types, "General Service," "Portable Standard" and "Torsion" are offered with the assurance that within their field there is nothing better obtainable—from anyone, anywhere. Send for Bulletin No. 82. It describes all types.



"General Service" Type.

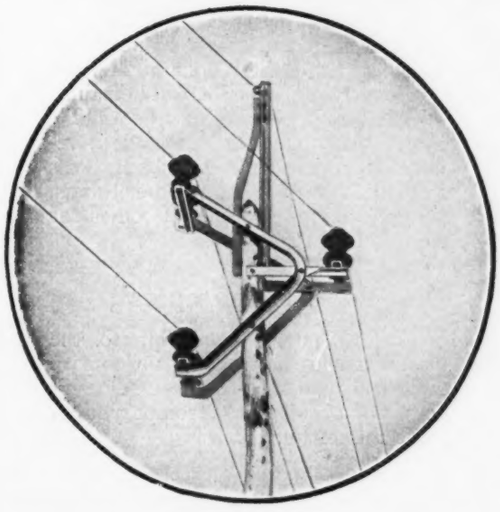
ROLLER-SMITH COMPANY

203 Broadway, New York

Monadnock Block
Chicago

Williamson Bldg.
Cleveland

Armed for the Winter Campaign



The stress and strain of winter winds and ice-laden wires are a yearly menace to overhead lines unless every pole is strongly armed for the conflict.

"BO-ARROW" ARMS
Withstand the storm strains

"Bo-Arrow" design lends a strategic advantage to these arms in that the arm arrangement affords a brace that can't be budged even when subjected to the most unequal stresses. Made of hot-rolled, open hearth steel, rust-proof by heavy hot-dip galvanizing, they will last a lifetime.

Write for the new Hubbard Reference Book.

The Hardware MAKES the line.

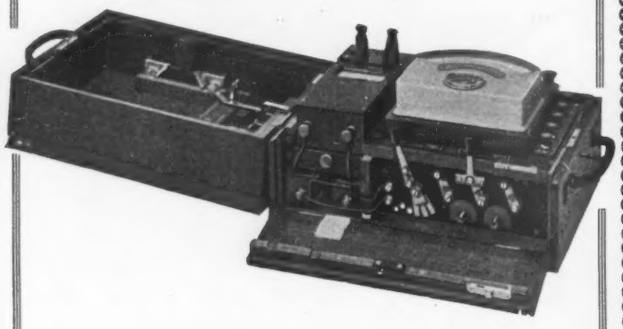
Hubbard Makes THE HARDWARE

HUBBARD AND COMPANY
PITTSBURGH, PA.

71853 2

Industrial Potentiometers

(*S-H Standardizing Set*)



Every Public Service Company needs some ready means of "checking" commercial ammeters, voltmeters and wattmeters. *There is no doubt about it;* but the difficulty has been to secure a testing outfit that could be operated successfully in the Meter Department of a company of *average size* where laboratory experts are not always at hand.

These requirements are now met very perfectly by the *"S-H" Standardizing Set,* manufactured for us by Messrs. Siemens & Halske, A. G.

It is an industrial potentiometer—designed from an *industrial* viewpoint; and with it anyone of ordinary skill can quickly calibrate portable or switchboard instruments, *as accurately as the scales of the instruments under test can be read.*

When A. C. instruments are to be tested, it is necessary to use transfer-standards which read alike on alternating and direct current—exactly as with any other potentiometer.

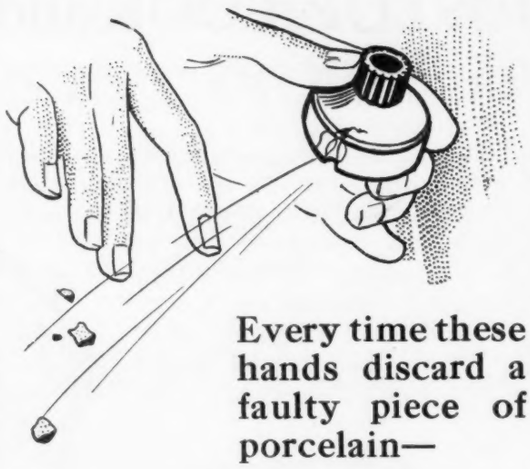
The "S-H" Standardizing Set and other precision instruments made by Siemens & Halske are described in our *Catalogue 771.*

If the subject interests you, write for a copy today.

We carry a supply of S-H Standardizing Sets for prompt shipments

JAMES G. BIDDLE
1211-13 Arch Street
Philadelphia

Be Sure to Visit Our Permanent Exhibit



Every time these hands discard a faulty piece of porcelain—

you lose money

An imperfect fit—a tightly driven screw—and the hands which assemble your electrical specialties reach for a *new* piece of porcelain. How many times a day it occurs in your plant! Yet the expense is not inevitable. It can be greatly reduced by using

STAR

Perfect Porcelain

"Star" Porcelain, among those who use it, stands for Better Porcelain—which means better Workmanship—molding as accurate as your needs demand. In the "Star" plants all work is done by thinking, careful, trained WORKERS. This means QUALITY—and this quality is reflected in reduced porcelain and assembling costs in YOUR plant. Among other things, we are now making special bodies for electrical heating units.

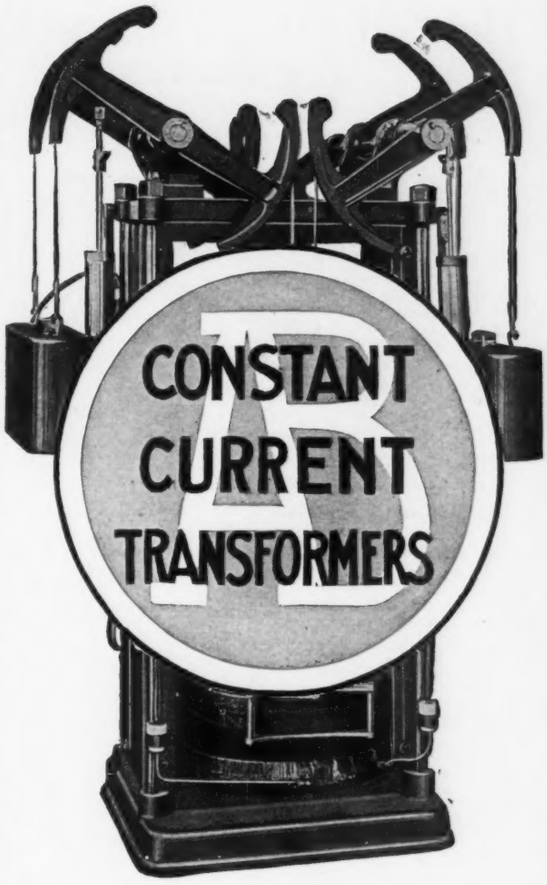
Write for samples

of "Star" porcelain similar to the pieces you are now using. Compare them with yours for quality. Doesn't your good judgment prompt you to make this examination?

The
STAR
PORCELAIN COMPANY
TRENTON NEW JERSEY
and a new plant at Frenchtown N.J.

41196 1

The Movable Member of A-B Constant Current Transformers Never "Sticks"



Perfect Operation with Minimum Attention is Assured

No more annoying feature of imperfect constant current transformer operation can be named than the sticking or binding of the movable member, or mechanism, attached to it. Current gets high and expensive burnouts of costly Mazdas is the result. A-B Constant Current Transformers are built so that they *won't stick*. Write for data on A-B efficiency.

The Adams-Bagnall Electric Co.
Cleveland, Ohio

71499

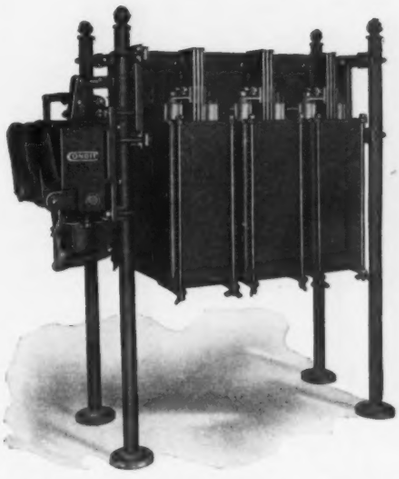
THE SIEGE GUN

of Circuit Breaker Design, and

THE BEST DEFENSE

against the disastrous effects of overloads, short-circuits and failure of voltage on alternating-current circuits of high ampere-capacity is the

CONDIT



Type Y Oil Circuit Breaker

Capacity, 6000 amperes or less; 3300 volts or less.
Repeat orders prove its worth in service—the ultimate test.

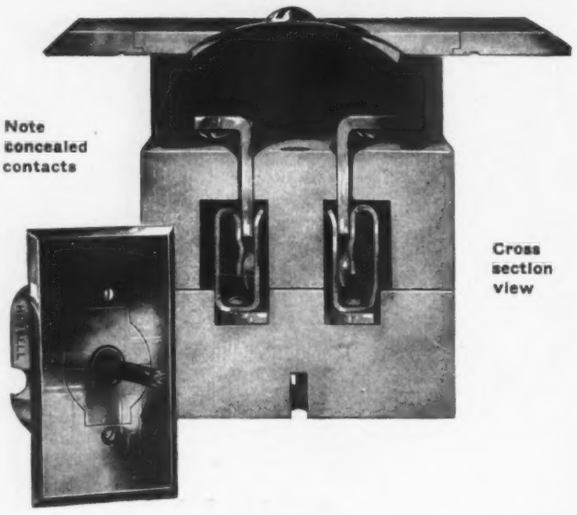
Write for Bulletin 408.

Condit Electrical Mfg. Co.
Boston, Mass. U. S. A.

New York, 39 Cortlandt St.
Philadelphia, 1011 Chestnut St.
Pittsburgh, 422 First Ave.
Akron, Flat Iron Bldg.
Seattle, 316 James St.
Chicago, 318 West Washington St.
Atlanta, 1206 Empire Bldg.
Denver, 1621 17th Street.
Birmingham, Brown-Marx Bldg.

Northern Electric Company
LIMITED

Sole Distributor for the Dominion of Canada, Montreal, Halifax, Toronto, Winnipeg, Regina, Calgary, Edmonton, Vancouver, Victoria.



The concealed contacts of Hubbell Interchangeable Receptacles can be demonstrated in a way to convince the layman. It is impossible to touch the contacts in any way except by inserting the blades of the plug.

Let us tell you more about this line—the styles, finishes, prices, etc.

HARVEY HUBBELL, Inc.
BRIDGEPORT, CONNECTICUT.

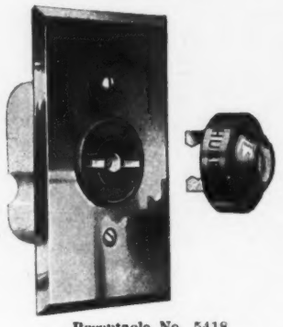
Train a Customer, Electrically, The Way He Should Go—

And he will not depart therefrom.

The average man doesn't know much about electrical installation; he's willing to leave all that to people who are in the business. However, he has attached the electric cord to lamp sockets and twisted the old style screw-in plug. The minute he is shown the versatility and convenience of

Hubbell Interchangeable Receptacles

he appreciates the obvious improvement and becomes a lifelong convert to the simple Hubbell method.



Receptacle No. 5418
With Interchangeable Cap
Three-eighths Actual Size

Receptacle No. 5501
With Lift Cover
Three-eighths Actual Size

The Occasional Reader is Appreciated

but—

if it is good to read the Electrical World occasionally, it is better to read it regularly. Looking through some subscriber's copy is spending time to good advantage. Looking through your own copy is better. It is the **regular** reader who gets the most out of the Electrical World. He not only gets the best ideas of the electrical industry promptly. He gets something even more important—a view of the continuous movement toward progress—the only way to keep constantly in touch with the trend of the times. Inasmuch as progress is largely evolutionary rather than revolutionary, he who knows the direction of the progressive drift is best equipped to take advantage of it.

Read the Electrical World—read it every week.

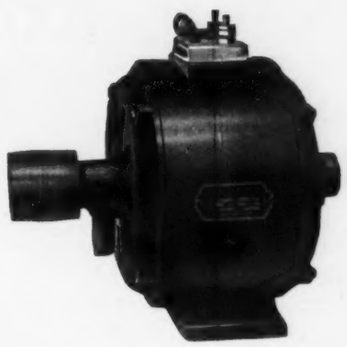
If you are not now a subscriber, send your subscription and make sure of having a copy of the Electrical World which you can clip or file for future reference.

Note: No special effort is being made to increase the *volume* of Electrical World circulation—now 20,000 copies per week. We are, however, always eager to *strengthen* the circulation by allowing subscriptions to lapse where the Electrical World is not used with maximum efficiency and to substitute subscribers who can and will make good use of the editorial and advertising pages. If you fit into the latter class, your subscription will be welcomed. Subscription $3.00 per year in the U. S., $4.50 in Canada, $6.00 elsewhere.

Electrical World, 239 West 39th Street New York

Member Society for Electrical Development
"Do it Electrically"

The Consistent Efficiency of Peerless Drive is an Invaluable Asset to Any Machine



Machines intended for non-mechanical consumers must be efficient — dependable — **trouble-proof.**

It's the possession of these very qualities that makes

PEERLESS MOTORS

Standard Equipment for High Grade Motor-Driven Devices

The consumer wants a machine that will operate when he wants and as long as he wants—today, tomorrow and **every** day.

That's the sort of service that Peerless Motors give. There's a Peerless that fits your service. If not, we'll build one. Write us about it.

The Peerless Electric Co.
Dept. "M."
Warren, Ohio

71539

Protection is Our Specialty

Metropolitan Service and Meter Protective Device

Metropolitan Protective Devices

have saved money and increased the **efficiency** of many
CENTRAL STATIONS.

Why not let them
do the same for you?

Fit any watthour meter.

Prevent theft of current.

Standardize methods of installation.

Reduce fire hazards by means of enclosing conductors around meter in metal.

Reduce cost of testing meters.

Provide for complete control of service and meter by Central Stations.

Provide ample protection against damage to meter, due to excessive overloads.

Let us send you full particulars.

Metropolitan Engineering Co.
42nd St. Bldg., New York

Canadian Representative — Metropolitan Engineering Co., Ltd., 90 Sherbourne St., Toronto, Canada.

This Trade Mark The Guarantee of Excellence on Goods Electrical.

Modern Manufacturing Methods Make Switchboards Less Expensive

Frank Talk About Switchboards No. 4

A very large percentage of all manufactured articles for common use are produced in quantities to certain specific, or standard designs. This is the modern method, and the only reason we can afford many of the comforts we now enjoy. Everyone knows that goods made to order are expensive, and that they are needed only to meet special requirements.

Consequently from hats or shoes to automobiles the average man selects from standard lines the particular size, shape or quality that best meets his desires and the price he is willing to pay.

This same condition prevails largely in the purchase of power plant equipment even in high capacity units. Boilers, engines, turbines, motors, generators and transformers are now mainly made to manufacturer's standard designs, which however, meet the customer's usual requirements.

The switchboard, however, is so closely related to all other parts of the plant and must provide for the characteristics of individual apparatus, that standardization has here necessarily been attained somewhat slowly.

The important fact **is** that it **has been attained.** Such standardization takes the form of "Standard Unit" panels, a proper selection of which will meet the requirements in a great many installations.

An illustrated booklet "Standard Units" explains the general characteristics of twenty-two different classes of these panels. It will show how to select what you may need from the thousands of standard unit panels available.

General Electric Company

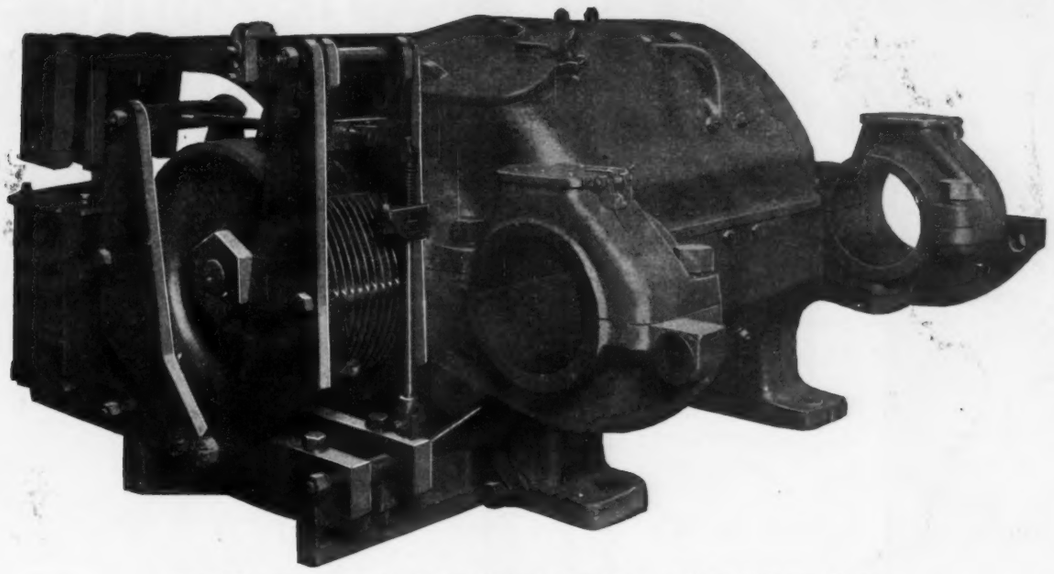
General Office: **Schenectady, N. Y.**

Sales Offices in All Large Cities

5259

This Trade Mark The Guarantee of Excellence on Goods Electrical.

This Trade Mark The Guarantee of Excellence on Goods Electrical.



The CR 9510 Automatic Solenoid Brake attached to Type MD 109 Motor

The "Safety First" Solenoid Brake

The unexpected causes most accidents. With electric brakes—the operator expects a quick sure stop—he depends on it. If the brake is not constantly adjusted for brake shoe wear the unexpected will happen.

The G-E Solenoid Brake is provided with automatic adjustment of all parts as the brake shoe wears. The adjustment takes place every day—every hour if needed—and being automatic—is practically free from the human negligence risk.

Get These "Safety First" and Low Maintenance Features:

The adjustment for brake shoe wear is automatic and does not depend upon frequent inspection to insure a reliable application of the brake.

The adjustment of the magnetic air gap is also automatic. Hence the pull is kept constant and sure as the brake wears.

Hammer blows are eliminated—on release, the bottom core of the solenoid hits a floating top core. On application the moving parts descend smoothly through the action of a spring or dashpot.

These brakes can be furnished for any make of alternating or direct current motor.

SPECIFY THE G-E SOLENOID BRAKE

General Electric Company

General Office: **Schenectady, N. Y.**

Sales Offices in All Large Cities

4826

This Trade Mark The Guarantee of Excellence on Goods Electrical.

KERITE
AN INVESTMENT
WHETHER the wire or cable be large or small, high or low tension—for any service and under all conditions—the most durable, efficient and permanent insulation known is KERITE.
KERITE INSULATED WIRE & CABLE COMPANY
NEW YORK CHICAGO

PARANITE
RUBBER COVERED WIRES & CABLES
If its PARANITE it is right
More than meets code requirements
Underground, Aerial, Submarine and Inside Use. Telephone, Telegraph, Fire Alarm, Electric Light and Power Wires and Cables
THE BEST FOR EVERY PURPOSE
INDIANA RUBBER & INSULATED WIRE CO.
JONESBORO, IND.
CHICAGO BRANCH:
210 S. DESPLAINES ST.
EASTERN REPRESENTATIVES:
THOMAS & BETTS Co. 105 HUDSON ST., N.Y.

OKONITE
TRADE MARK REG. U.S. PAT. OFF.
The STANDARD for RUBBER INSULATION
It is characteristic of OKONITE Wire and Cable insulation that it shows uniformly higher electrical resistance than that of any other wire on the market.
Made in one grade only—the BEST.
THE OKONITE COMPANY
253 BROADWAY, NEW YORK

PUBLISHER'S PAGE

An Element of Success

The Advertising and Sales department of the Burroughs Adding Machine Company is one of the largest and most effective in the world.

Its activities extend into so many fields of business and deal with so many classes that their studies of men have been unusually thorough.

Therefore, when the head of this great department makes a definite statement concerning a characteristic of successful men in general, it is worth noting.

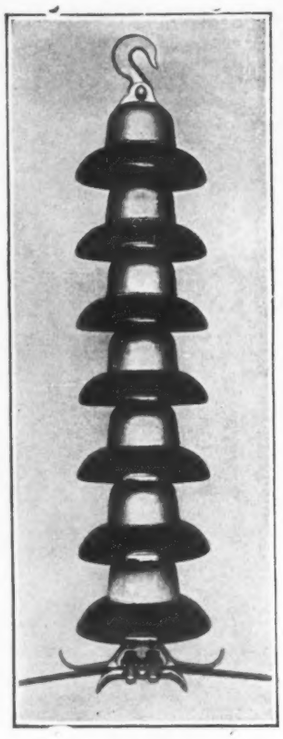
Mr. Robert H. Crooker, writing in the current issue of Printers' Ink, says this:

"In almost every instance it will be found that the successful man is the one who reads his trade paper regularly, with the thought in mind of making use of some of the ideas which have proved successful for others in the same line of business."

The man who reads his trade or technical paper shows the mental attitude which makes for success, and gains the kind of information which makes success for him possible.

And the man who makes his regular reading of the Electrical World cover the advertising pages as well as the text is better equipping himself for bigger things than is he who reads the text pages only or the advertising pages only.

Both are part of the paper—both add to the equipment that makes for success.



Chile Exploration Co. 110,000 Volt Insulator

An army of engineers and workmen are now engaged in expending millions of dollars developing a giant project in South America—the wonderful copper mine of the Chile Exploration Co.

The Power Pulse is an 80-mile, 110,000 volt transmission from the coast power house up into the Andes 9,000 feet in altitude.

The insulators for this line are peculiarly important. Thousands of miles of ocean transportation, 8 or 10 transfers and, finally laborious mule-back carry, lay between factory and erection. This, with the importance of the power and difficulty of patrol and repair, preclude the privilege of approximation in decision.

"Victor" insulators were selected.

The Locke Insulator Mfg. Co.
VICTOR, N. Y., U. S. A.

Works: Victor, N. Y. and Lima, N. Y.
New York City 50 Church Street

Make Your Line Construction Permanent

Galvanized Triangulate Steel Poles for the 23,000 volt transmission line to be constructed between Seneca Falls and Auburn, New York, by the Empire Gas and Electric Company

Steel Poles and Towers of Every Description, Galvanized or Painted

FRANKLIN STEEL WORKS
FRANKLIN, PA., U. S. A.

New York Office 50 Church Street | Denver Office McPhee Building | Minneapolis Office Phoenix Building

For Gift Makers

is our new booklet "The Dainty Way to Keep House." We are sending it into thousands of homes all over the country, upon request.

The Resultant Business

comes to you, and your responsibility in the matter is to **keep up your Simplex Stock,** and give inquiring customers **the goods they want.**

SIMPLEX QUALITY

Simplex Electric Heating Co.

Mfrs. of Everything for Electric Heating and Cooking

Cambridge, Mass.

15 S. Desplaines St., Chicago

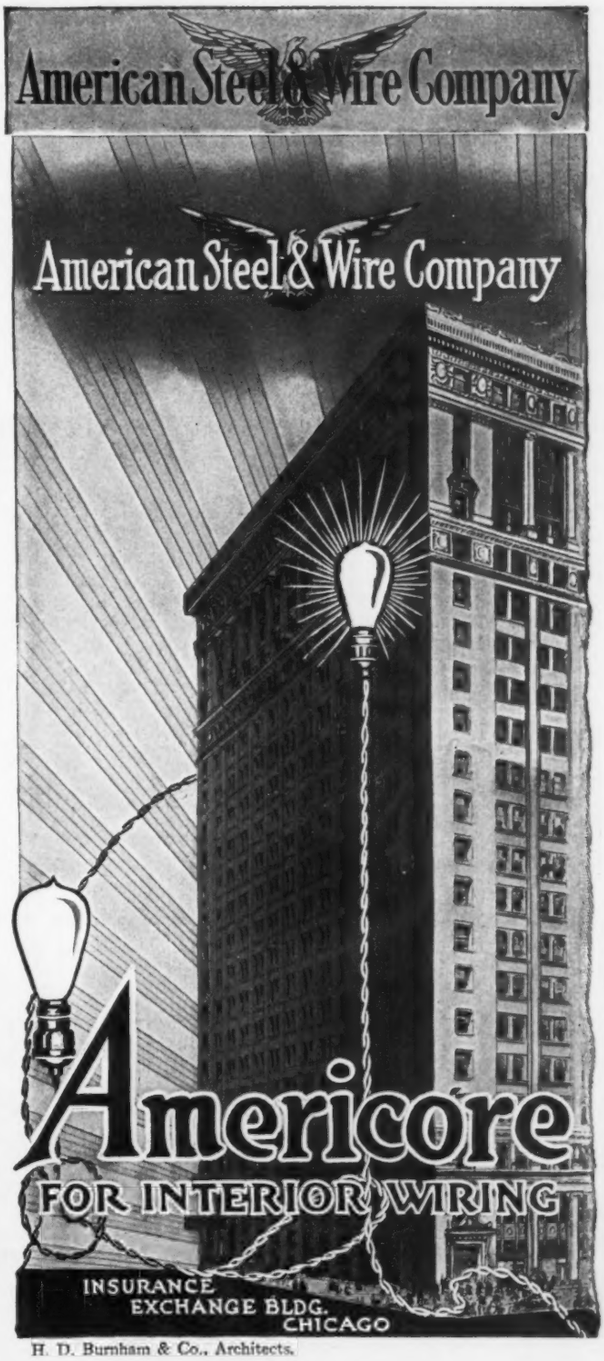
612 Howard Street, San Francisco, Cal.

Belleville, Ont.

BY INVITATION MEMBER OF

NEW YORK, U.S.A.

Member of The Rice Leaders of the World Association



H. D. Burnham & Co., Architects.

OVER 200,000 feet of our Americore rubber covered wire used in this building.

Every foot is carefully inspected by us in the various stages of manufacture, and when completed is finally examined and labeled under the direction of the Underwriters' Laboratories.

We are prepared to furnish this wire in all sizes and conductors, both solid and flexible, from warehouses conveniently located for quick delivery to all parts of the country.

Chicago New York Cleveland
Worcester Pittsburgh Denver

Export Representative: U. S. Steel Products Co., New York.
Pacific Coast Representative: U. S. Steel Products Co., San Francisco. Los Angeles, Portland, Seattle.

New Coils for Old!

Heatproof Ones, Too

Send us a few of your burned out field coils, armature coils or arc lamp coils. Don't send them to the junk-man to be sold for a few cents a pound. Send them to US.

Let us "SALAMANDERIZE"

Your armature and field coils

We will return them rejuvenated—reinsulated with our Salamander Asbestos Insulation. The new coils you'll get back for your old coils stand overloads that would mean destruction to your ordinary cotton-insulated kind. "Salamanderized" coils mean bigger emergency capacity for your machines—better protection for the continuity of your service. Send us a few coils *now* for demonstration.

Write for proof and quotations.

THE INDEPENDENT LAMP & WIRE CO., 1733 Broadway, N. Y.

Works: York, Pa., and Weehawken, N. J.

WIRE AGENTS:

Burrows, Sloan & Co., 1625 Real Estate Trust Bldg., Philadelphia.
W. R. Garton Company, 17 So. Desplaines Street, Chicago, Ill.
Stuart Howland Company, 133 Federal Street, Boston, Mass.
Charleston Electrical Supply Company, Charleston, W. Va.
B. F. Kieruff, Jr., Elec. Company, Los Angeles, Calif.
Wesco Supply Company, St. Louis, Mo.
Franklin Sales Co., Denver, Colo.
Gee Electric Company, Wheeling, W. Va.
Doubleday Hill Elec. Co., 919 Liberty Ave., Pittsburg., Pa.
Burton R. Stare, Seattle, Wash.
Hamilton Hill, 412 Boston Safe Deposit & Trust Bldg., Boston.
Engineering Equip't & Supply Co., 410 St. James St., Montreal, Canada.

71778 2

AMERICAN BRIDGE COMPANY

HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS

Track Spans, Panama.

SALES OFFICES

NEW YORK, N. Y., 30 Church Street
Philadelphia, Pa., Pennsylvania Building
Boston, Mass. . . John Hancock Bldg.
Baltimore, Md., Continental Trust Bldg.
PITTSBURGH, PA. . . Frick Building
Rochester, N. Y. . . . Powers Block
Buffalo, N. Y. . Marine National Bank
Cincinnati, Ohio . Union Trust Building
Atlanta, Ga. . . . . Candler Building
Cleveland, Ohio . Rockefeller Building
Detroit, Mich., Beecher Ave. & M.C.R.R.
CHICAGO, ILL., 208 South La Salle St.
St. Louis, Mo., Third Nat'l Bank Bldg.
Denver, Colo., First Nat'l Bank Building
Salt Lake City, Utah, Walker Bank Bldg.
Duluth, Minn. . . . . Wolvin Building
Minneapolis, Minn., 7th Ave. &2nd St., S. E.

Pacific Coast Representative:

U. S. Steel Products Co. Pacific Coast Dept.
SAN FRANCISCO, CAL., Rialto Building
Portland, Ore. . . . . Selling Building
Seattle, Wash., 4th Ave. So. Cor. Conn. St.

Export Representative:
United States Steel Products Co., 30 Church St., N. Y.

"Design of Excellence"

Write for

BULLETIN No. 104

Contents:

	Page
Barrier Clamps	13
Bus Bar Clamps	11
Cable Racks	13
Cable Steps	13
Clevises	9, 10
Floor Air Boxes	12
Floor Bushings	14
Floor Flanges	5, 7
Ground Caps	13
Insulating Compound	13
Line Insulators	14
Miscellaneous Tables	15, 16, 17, 18, 19
Pipe Fittings, Malleable Iron	4, 5, 7, 8, 9, 10
Switchboard Bolts	12
Switchboard Fittings, Malleable Iron	6, 7
Tape	13
Transformer Water Bells	13
Wall Bushings	14

also if interested

Bulletin No. 101 Disconnecting Switches
Bulletin No. 102 Cable End Bells
Bulletin No. 103 Bus Bar Supports

Electrical Engineers Equipment Co.

Designers and Builders of

Power Plant Appliances

711-715 Meridian Street
CHICAGO, U. S. A.

RALPH B. CLAPP, Los Angeles, Cal. — LEWIS-ROTH CO., Philadelphia, Pa.
VERNE W. SHEARER & CO., Akron, Ohio

Northern Electric Company LIMITED
Distributors for Canada

"Design of Excellence"

"He Done Witch Himself"

is the verdict of a post-mortem in Middle Congo when the cause of death is unknown.

Every race has a stock phrase to throw aside any subject which it cannot master.

Just as Power House operators will explain away some unknown machine trouble by the old reliable **"It's cranky,"** when as a matter of fact the poor machine is throwing out symptoms of improper brush application.

That is why we **insist** that brushes should be prescribed for you, not merely sold to you.

In our organization brush **engineering** is inseparable from brush **selling.**

But it is up to us to prescribe the Morganite or Battersea brushes you need—that's good commutation insurance.

Morganite — The Morgan Crucible Company Limited, 114 Liberty St New York — Battersea

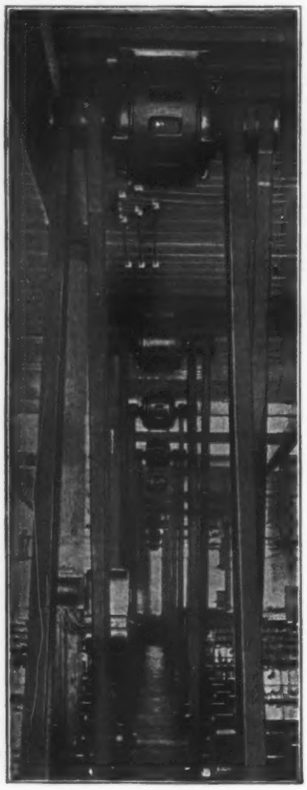
Factory, Brooklyn

AGENTS :

Lewis-Roth Co., 312 Denckla Bldg., Philadelphia

Electrical Engineering & Mfg. Co.
First National Bank Bldg., Pittsburgh

389



FOR EVERY PURPOSE

The high efficiency and power factor of Allis-Chalmers Induction Motors, over a wide range of loads, together with their ability to maintain a constant speed, renders them particularly adapted to many different kinds of work.

For special needs their construction is modified to meet the conditions. For instance: special moisture-proof insulation is used on motors intended for service in damp locations such as mines, caissons, excavations, etc.

Allis-Chalmers Alternating Current MOTORS

of the squirrel cage type have no rubbing parts, which eliminates danger of sparking. These motors (type A N) are therefore especially favored for use in places where highly inflammable materials, chemicals or gases are present.

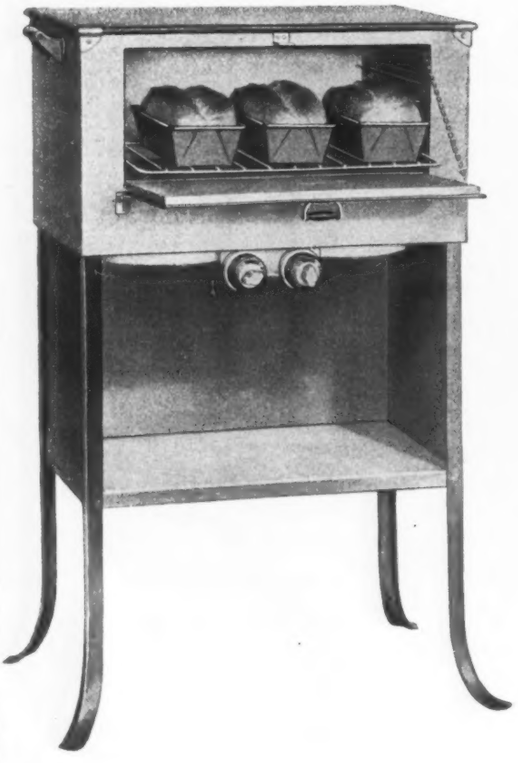
Large starting torque and overload capacity enable them to give good satisfaction where they are likely to be subjected to large instantaneous overloads, and overloads of longer duration.

Write for Bulletin No. 1081.

Allis-Chalmers Mfg. Co. Milwaukee, Wis.

FOREIGN DISTRICT OFFICES:
London, England, 732 Salisbury House, London Wall, E. C.
Santiago, Chile, Huerfanos 1157, Casillo 2653.

2



Another Hughes Step in Advance!

HERE'S A NEW ONE TO MEET THE DEMAND FOR A LOW PRICED ELECTRIC STOVE

$25 The Hughes No. 17 $25

This stove is one you have been waiting for. It completes the line of high-grade electric stoves. You will find it a "winner." Its price of $25 retail (in Canada $30) places it well within the means of the ordinary home.

Like all our apparatus the Hughes No. 17 is built for heavy duty. It has two burners, is artistically finished in blue polished steel and black enamel. Stove and oven complete weigh but 60 lbs.

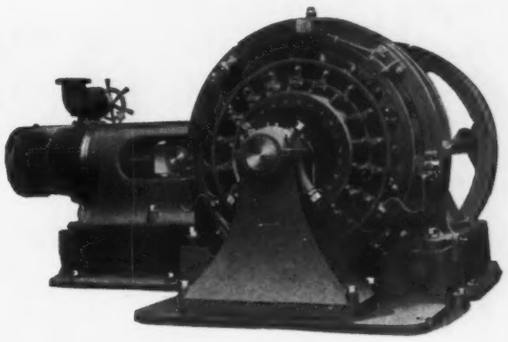
Has improved oven which gives perfect baking results.

Its low maximum demand (2 k.w.) will be of special interest to Central Stations. Write for complete description and general catalog.

Hughes Electric Heating Co.

213 W. Schiller St., Chicago, Ill.
Canadian Factory, Winnipeg

Generator Ratings are Sometimes Misleading



Ordinarily they depend solely on the ability of the machine to commutate without destructive sparking. It's different with the generator of a

Ridgway Unit

Its capacity to carry overload is limited only by the ability of its insulation to stand the heat due to C^2R and core losses.

Our compensated field winding holds the commutation plane absolutely stationary, thus positively eliminating sparking, no matter what the overload.

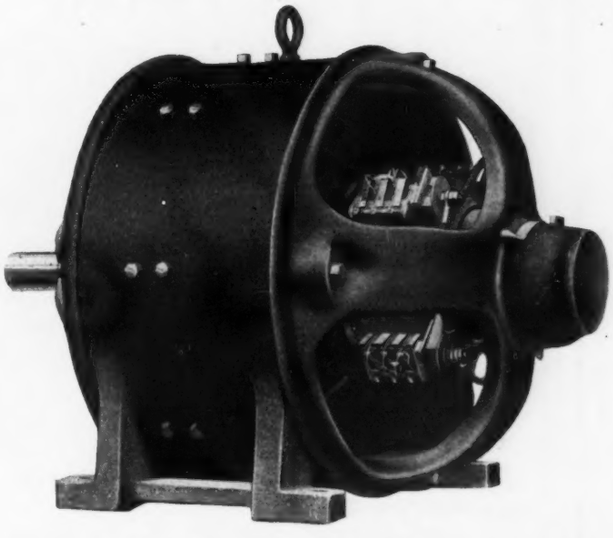
Ridgway Bulletins go into detail. Ask for them.

Ridgway Dynamo & Engine Company

Ridgway, Pa.

RELIANCE

A Rugged Motor for Constant Speed Service



Steel frames, liberal bearings and shafts are found in all Type R Reliance Constant Speed Motors. Every part is made to stand the wear and tear of hard service.

Armatures for all motors larger than 5 h.p., 1150 r.p.m. are built on spiders, so that the shafts can be readily removed without disturbing the windings.

Commutators are of the bolted type and made with the best hard drawn copper bars.

At the pinion end of the armature a cast iron end flange, which is a part of the armature spider, protects the armature coils and gives a rigid support.

These are important details—get them by specifying Reliance Motors.

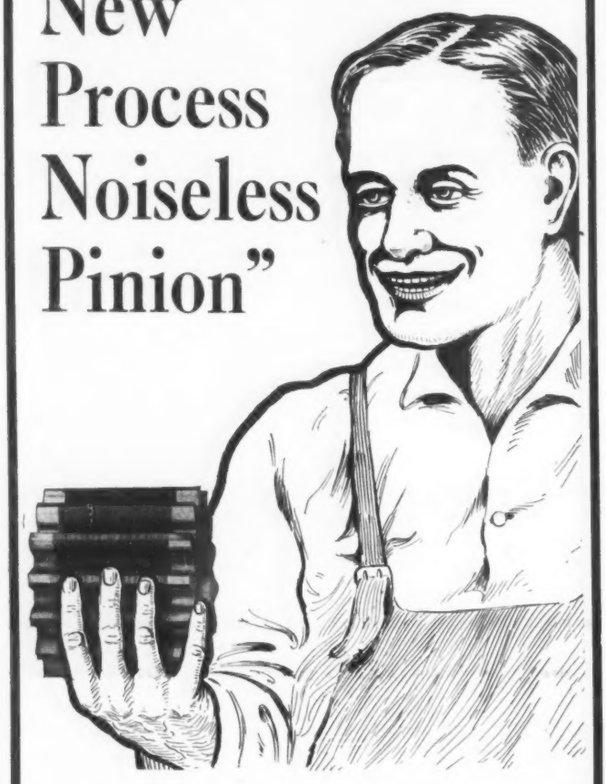
RELIANCE ELECTRIC & ENGINEERING COMPANY

1046 Ivanhoe Road, Cleveland, Ohio

Branch Sales Offices: New York, Philadelphia, Chicago

"There won't be any more noise around here after we put on this

New Process Noiseless Pinion"



Complete utilization of the brain power of your assistants and operatives demands quiet surroundings. Noises considered permissible only a few years ago are now condemned by efficiency experts and medical advisers alike.

Why not suppress the useless gear noises by replacing offensive metal pinions with quiet New Process Rawhide Pinions—which would help bring your plant and your output up to present day high standards and at the same time earn the gratitude of your employes?

N.P.R.H. REG. U.S. PAT. OFF.

NEW PROCESS IS TO ALL OTHER RAWHIDE AS STEEL IS TO IRON

NEW PROCESS GEAR CORPORATION

SYRACUSE, N. Y.

Canadian Agents: Robert Gardner & Sons, Ltd., Montreal

The On-Time Advertiser

who gets his copy and cuts to us well before the day his advertisement should go to press, gets better type composition, better location and a better opportunity to make necessary corrections on the proofs which can then be submitted before publication.

The Last-Hour Advertiser

whose copy and cuts come in at the last minute or even later, gets the best attention we can possibly give him. We work overtime to do what we can for him. But the lack of sufficient time makes it physically impossible to do as well for him as for the advertiser whose instructions come in well before the last hour.

Get Your Copy and Cuts in Early

Do this, not on our account, but for the sake of your own advertising. We want to serve all advertisers equally well—but we can't put more hours into a day, and the advertiser who gives us the most time gets the best results.

Copy and cuts should be in our hands by Friday of the week preceding the date of issue. This means that Friday is the *last* day on which copy can be handled normally.

After that we cannot promise proofs, and we cannot insure classification.

For good advertising, get your cuts and copy in every week *before* Friday.

Electrical World

239 West 39th Street, New York

TRADE DAUM MARK

Renewable Fuses

have been adopted as standard by the largest users of fuses in the world. There are reasons. Can we demonstrate?

Can be made to fit any old code fuse block in use. This is an exclusive feature. Send sample of any old code fuse in use and we can make it a refillable fuse.

Sample up to 100 amperes for the asking, on your letterhead.

Bulletins for the asking.

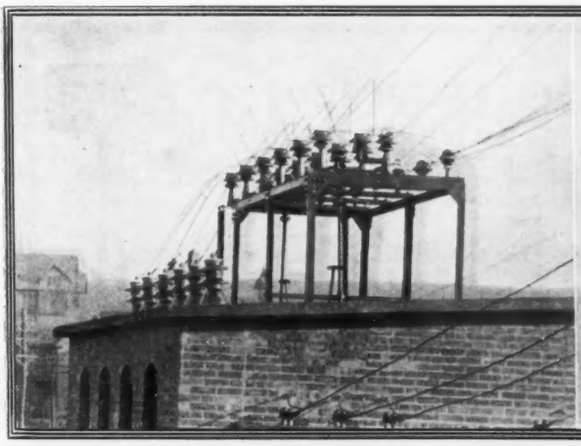
A. F. DAUM CO.
SOLE MANUFACTURER
PITTSBURG, PA., U. S. A.

The Heaviest Short-Circuit Can't Arc Across "D & W" High Tension Cutouts

The instant the fuse blows the terminals are forcibly *thrown apart* and a heavy-bodied special oil interposes, effectively preventing arc formation. An efficient venting system obviates the blowing out of oil. Flexible cable terminals are provided for ready connection to line. Re-fusing is made absolutely safe even when the line is short-circuited. Here is a cutout that fulfills a long-felt want. An investigation will show its efficiency for your service. *Write.*

D & W Fuse Company
Providence, R. I., U. S. A.

1



BURKE HORN GAP SWITCHES
LIGHTNING ARRESTERS
FUSES AND OUT DOOR
SUB STATIONS COMPLETE

WRITE FOR CATALOGUE

RAILWAY AND INDUSTRIAL ENGINEERING CO.
PITTSBURGH, PA.

NEW YORK AGENT 30 CHURCH ST.

WORKS & MAIN OFFICE: GREENSBURG, PA.

The American Brass Co.

BENEDICT & BURNHAM BRANCH
Successors to
THE HOLMES, BOOTH & HAYDENS CO.
WATERBURY, CONN.

SUPERIOR WEATHER PROOF "K.K." ELECTRIC WIRES
TRADE MARK

Manufacturers of
"K.K." Weatherproof Wire and Cable
Bare Copper Wire and Cable
Slow Burning Weatherproof Office Annunciator and Magnet Wire

NEW YORK OFFICE
99 John Street

ALUMINUM

Aluminum Company of America
Pittsburgh, Pa.

Electrical Conductors
Ingot Sheet Wire
Rod Tubing

Sales Offices:—
New York Cleveland
Boston Detroit
Chicago Philadelphia
Kansas City Rochester, N. Y.
Washington

3

FIELD
COILS
SOLENOIDS
ELECTRO
MAGNETS

THE ACME
WIRE COMPANY
NEW HAVEN
CONNECTICUT

BAKELITE MOULDED
COMMUTATORS

Moulded by Diehl Mfg Company

Save Cost of Mica V-rings eliminate slow and expensive assembling and insure absolutely tight commutators.

BAKELITE
REG. U.S. PAT. OFFICE

High Dielectric and Mechanical Strength—Impervious to oil and dust—will not soften by heat, or deteriorate with age.

GENERAL BAKELITE COMPANY
100 William St. New York
55-110

The MAN for the Job

ELECTRICAL WORLD
"Positions Vacant"
and
"Positions Wanted"

Columns bring together desirable employers and desirable employes.

The JOB for the Man

Chicago
Rawhide Mallets

save battered-up machine parts in any shop where assembling or repairs are done.

Rawhide being a non-conductor of electricity, these mallets are especially adapted to electrical work.

Write for quantity prices.

The Chicago Rawhide Mfg. Co.
1301 Elston Ave., Chicago

Roebling Wires

for electrical purposes, include annunciator, office, magnet, weatherproof and rubber covered wire, lamp cord, heater cord, telephone and power cables and other electrical wires.

John A. Roebling's Sons Co.
Trenton, New Jersey

For That Quick Repair Job

—when heavy lighting loads are taxing your capacity to the limit—use

WALPOLE

Black Finishing Varnish

It can be applied over any other varnish, and finishes with a tough, elastic, water-proof, oil-proof and acid-proof coat. Air-dries in about 30 minutes.

Write for booklet on Walpole Varnishes.

Massachusetts Chemical Co.'s Products

WALPOLE TIRE & RUBBER COMPANY
Walpole, Mass.

Pioneers in Insulation Engineering

5

Made in AMERICA

PURE MALLEABLE

NICKEL

in the form of

WIRE STRIP SHEET

RESISTANCE ALLOYS

WIRE STRIP SHEET

"Nichrome"	For Electric Heaters
"Advance"	For Instruments
"No. 193 Alloy"	For Rheostats
"Therlo"	For Shunts

Full Data and Prices Sent on Request

DRIVER-HARRIS WIRE CO.
HARRISON (NEWARK), N. J., U.S.A.

M

Look for the Diamond M

Magnet Wire

We carry a complete stock of cotton, silk and enamel magnet wire in our various warehouses throughout the country.

ALFRED F. MOORE
200 N. Third St., Philadelphia
NEW YORK CLEVELAND CHICAGO BOSTON
CHATTANOOGA NEW ORLEANS

Blake Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds. 5 Sizes. Pat. Nov., 1900. Write for Samples.

Blake Signal & Mfg. Co.
Boston, Mass.

American Vulcanized Fibre

Our District Offices will be glad to take care of the inquiries and orders from towns in their vicinity.

We can fill orders from stock in New York, Chicago and St. Louis.

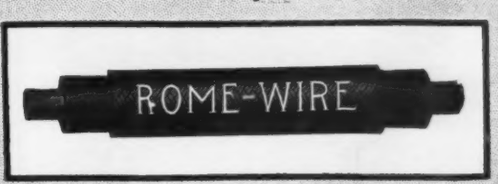
DISTRICT OFFICES

6 Murray St., New York.
12 Pearl St., Boston.
321 St. Paul St., Baltimore.
973 Drexel Bldg., Philadelphia.
1810 First National Bank Bldg Cincinnati.
186 N. Market St., Chicago.
643 Pierce Bldg., St. Louis.
303 Oliver Bldg., Pittsburgh.
401 Boyer Bldg., Detroit.
719 Citizens' Bldg., Cleveland.

AMERICAN VULCANIZED FIBRE CO.
Wilmington, Del.

ROME WIRE CO.

ROME, N. Y.



ROUND, SQUARE, FLAT MAGNET WIRE
COTTON, SILK, ENAMEL INSULATIONS

"Beldenite"
TRADE MARK

N. E. C. S.

LAMP CORD

Meets every requirement of Architects, Engineers and the Underwriters.

Distinguished by a blue and yellow thread laid parallel with the wire between the braid and rubber insulation.

Write for our prices

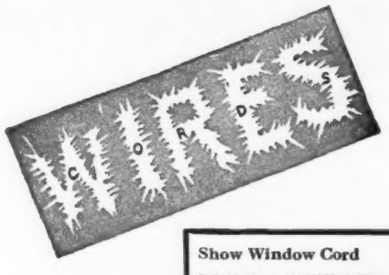
Belden Manufacturing Company
2301 South Western Avenue Chicago

Elasticity
of the individual poles in a transmission line is of the highest importance. Both our
"A" Frame
and
Laced Channel Poles
will bend and twist without permanent distortion. The "A" Frame shown went back to its original position after being twisted nearly 90°.

Design and Manufacture of Wire Supporting Structures Exclusively

ARCHBOLD-BRADY CO.
SYRACUSE, N. Y.

INSULATING MACHINERY
BRAIDING, TAPING, WINDING, TWINING, CABLING, STRANDING, POLISHING AND MEASURING MACHINES, CABLE COVERING BRAIDERS.
FINE CASTINGS A SPECIALTY
NEW ENGLAND BUTT COMPANY
403 PEARL STREET 4 PROVIDENCE, R. I., U. S. A.



Show Window Cord **Lamp Cord**
LOWELL INSULATED WIRE CO.
Lowell, Mass.
N. E. C. S. Wire **Telephone Wire**

PERFECT
MICANITE
INSULATOR
REGISTERED

And Other Dependable Insulations
Bulletins for the asking
Mica Insulator Company
Manufacturers
68 Church Street **542 So. Dearborn Street**
New York **Chicago**
Schenectady, N. Y.

GOULD STORAGE BATTERIES
For central station service, propelling street cars, electric vehicles, low voltage lighting systems, etc. WRITE FOR LITERATURE.
Gould Storage Battery Co.
General Offices:—30 E. 42nd St., New York City. Works:—Depew, N. Y. Branch Offices:—Boston, Philadelphia, Cleveland, Detroit, Chicago, San Francisco, Los Angeles; Agents in all large cities of United States and Canada.

WINDING MACHINERY
FOR INSULATING WIRE
AMERICAN INSULATING MACHINERY CO.
N. W. cor. Hancock and Oxford Streets, PHILADELPHIA, PA.

GRIPPER & SIDE GUIDE

"UNION" ELECTRICAL PROTECTING MATERIAL

Protect Your Investment

The man who has a bad fire congratulates himself if his risk was insured. You can protect your generators and motors against damage from dangerous overload if you use the proper fuses. The cost will be slight in proportion to the value of your equipment.

"UNION" Enclosed Fuses have stood the test of time and can be depended upon to open the circuit at a predetermined overload. Why not use them?

A large saving can be effected by returning blown Knife-Blade Fuses for reloading at the Factory.

Complete information in Fuse Catalog No. 26. Ask your Jobber or write us for a copy.

CHICAGO FUSE MFG. CO.
CHICAGO NEW YORK

Our 1000 Ton Stock Insures Prompt Deliveries

DISFICO
TRADE MARK REGISTERED

Take it all around—for toughness—for insulating qualities — for tensile and compressive strength—for ease of working—for imperviousness to oils and chemicals.

DIAMOND VULCANIZED FIBRE

is the ideal insulating material for hundreds of electrical uses.

But it must be well and thoroughly *cured*. All our Fibre has been cured for from six months to two years. Our 1000 ton stock insures prompt deliveries.

For chemically treated paper insulations try Disfico Horn Fibre and Diamond Insulation. Write for prices.

Diamond State Fibre Co.
Elsmere, Del. Chicago, Ill. Bridgeport, Penna.
71298 3

THE
National Conduit & Cable Co.
Executive Offices: 41 PARK ROW, NEW YORK, N. Y.

Bare Copper Wire and Cable
Weatherproof Wire and Cable
Office and Annunciator Wire and Cable
Paper Insulated Cable
Power, Telephone, Telegraph

Boston Philadelphia Chicago San Francisco

DOLPHIN
INSULATED WIRE

Notable for its uniformly high quality and dependability.

DOLPHIN ATLANTIC

ATLANTIC INSULATED WIRE & CABLE COMPANY
Sales Office:
120 Liberty Street, New York
Factory: Stamford, Ct.

Commercial Code

HIGH TENSION
POLE SWITCHES
OUTDOOR SUB-STATIONS
DELTA STAR
ELECTRIC-CO CHICAGO
7000 "UNIT" BUS BAR SUPPORTS
ASK FOR TECHNICAL BULLETINS

CABLING MACHINERY

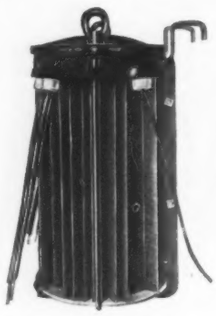
AND SPECIAL MACHINERY of any description

The Torrington Mfg. Co.
Torrington, Conn. U. S. A.

Send for Price List on
ELECTRICAL SLATE
Davis Slate & Mfg. Company
608 E. 40th St. Chicago

SIMPLEX WIRE & CABLE CO
MANUFACTURERS
201 DEVONSHIRE ST., BOSTON
CHICAGO SAN FRANCISCO

GRIPPER & SIDE GUIDE



PRESSED STEEL CASES

MADE IN AMERICA

This is a development originated by

Pittsburgh Transformer Company

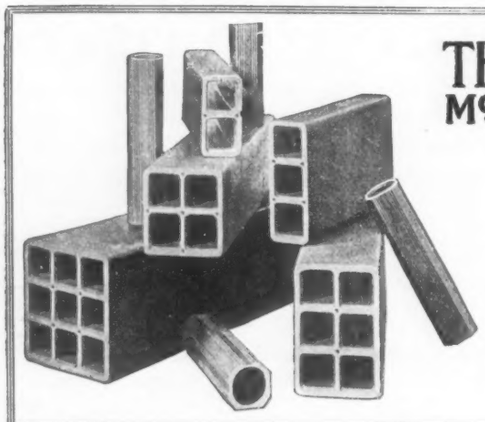
Largest Manufacturers of Transformers exclusively in the United States

Pittsburgh, Pa.

Western District Office
724 Harris Trust Bldg., Chicago, Ill.

Bulletin 1280

Rumsey Electric Company, Philadelphia.
Wetmore-Savage Company, Boston.
Iron City Electric Company, Pittsburgh.
A. Hall Berry, New York.
Interstate Electric Company, New Orleans.
Northwestern Supply Company, Seattle, Tacoma.
Jaspersen Supply Company, St. Marys, O.
Federal Sign System (Electric), Chicago, New York, San Francisco
Verne W. Shear & Co., Akron.
The Korsmeyer Company, Lincoln, Neb.
Burgess Electric Company, Duluth.
R. B. Clapp, 600 San Fernando Bldg., Los Angeles, Cal.



THE STANDARD FOR QUALITY
McROY — CONDUITS — CAMP
The Pioneer Manufacturers

Specify either of the above standard makes when writing your underground specifications.

Factories East and West enable us to figure reduced freight rates, assuring you of the lowest delivered prices without sacrificing quality in any way.

Large stocks of both single and multiple duct constantly carried, thus insuring an early delivery.

Our conduits have been used for twenty-three years. Inquire about us in any city where conduits have been installed.

McROY CLAY WORKS
The Rookery, Chicago

H. B. CAMP COMPANY
New York Pittsburgh Chicago

Transformers, Compensators and Reactance Coils for Tungsten and Nitrogen Lamps

Kuhlman Electric Co.

Transformer Builders

20 YEARS EXPERIENCE Elkhart, Ind.

"Just Press a Button"

to start — stop — reverse — accelerate — decelerate

The Monitor System of automatic control for electric motor drive

Monitor Controller Company, 111 So. Gay Street, **BALTIMORE**

New York . 30 Church Street
Philadelphia . 1533 Chestnut St.
82-95
Chicago: 1040 Old Colony Bldg.
Boston: . 77 Franklin Street

THE OVEN EQUIPMENT AND MANUFACTURING CO.

E&M Co.

New Haven, Conn. **JAPANNING OVENS**

84-39

C. O. BAKER, Pres. C. W. BAKER, Vice-Pres.

PLATINUM

Wire, Sheet, Rivets and Contacts. All of Baker Standard Quality. Scrap Purchased or Exchanged.

BAKER & CO., Inc.
Murray & Austin Streets, Newark, N. J.
New York Office, 30 Church St.

Approved Universal Bushings

FOR FLEXIBLE TUBING
"LOCKS IT TO THE BOX"
Sold by all good Jobbers

New Process Specialty Company
Milwaukee, Wis.

Over Half the Readers

of the advertising pages depend upon illustrations to attract them. Are your advertisements "attractive"?

DIM - A - LITE

A turn down attachment for electric lights—not a lamp.
Gives 5 changes of light.
Saves 80% when turned on lowest step.
Write for new catalogue.

WIRT COMPANY, Germantown, Philadelphia

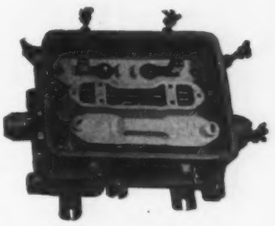
Can You Instantly, Easily, Isolate Trouble On Your System?

Are your protective devices and cutouts efficient, reliable, low in first cost and in maintenance cost? Do they enable you immediately to locate and isolate any section of your system affected by trouble? Users of G & W DEVICES can answer any or all of these queries with an unqualified affirmative. Can *you?* Write for the G & W Catalog.

Two-conductor Pothead mounted on conduit.

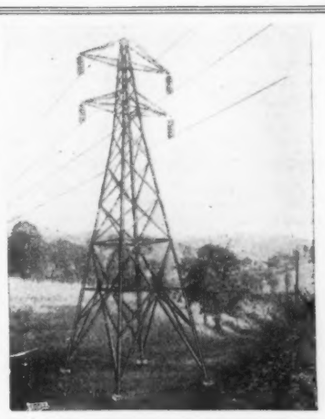
G & W Electric Specialty Company

6306-10 Blackstone Ave., Chicago



Combination Pothead and Subway cutout, 2300 volts, interior view.

71529



Transmission Towers

Galvanized and Painted

STEEL STRUCTURES

Of Every Description

Founded 1802

Wm. B. Scaife & Sons Co. Pittsburgh, Pa.
N. Y. Office, 26 Cortlandt St.

Blaw **STEEL BUILDINGS**
BRIDGES-STEEL POLES
TRANSMISSION TOWERS
BLAW STEEL CONSTRUCTION CO.
GENERAL OFFICES & WORKS, PITTSBURGH, PA.
NEW YORK OFFICE, 165 BROADWAY. CHICAGO OFFICE, PEOPLES GAS BUILDING.

If you do not find what you want

in the Searchlight Section of the WORLD, write us and we will try to get it for you.

HIGH TENSION SWITCHES

Oil Break, Air Break
all Types—Any Voltage

Pacific Electric Mfg. Co.
SAN FRANCISCO, CAL.

At Bargain Prices

150-6 Volt, 12 Ampere, Dynamos

New, high-grade, guaranteed. Suitable for battery charging, low voltage work, experimental purposes, automobile or motor boat lighting.

The ESTERLINE Co., 232 E. South Street Indianapolis

TOOLS

for all classes of electrical construction and repair work. Write for catalog.

Mathias Klein & Sons Canal Station 32 **Chicago**

UNIVERSAL TEST CLIP
INSULATED

Time savers in any electrical work requiring quick temporary connections.

Unexcelled for test sets—meters—ignition cell charging.

Free sample—use company letter-head or state your position.

Actual size

R. S. MUELLER & CO., 424 High Ave., S. E., Cleveland

PARAGON GROUND CONES

You'll not be willing to bet us that your Grounds are as easy to install, as economical and efficient as Paragons if you investigate them. Just drop in post holes—that's all.

Adopted by U. S. and Canadian Governments. Recommended by Interstate Commerce Commission. Choice of experts. At all jobbers. Write for prices and information.

PARAGON ELECTRIC CO.,
3 S. Clinton St., Chicago. 610 First Ave., Seattle.
212 W. Third St., Los Angeles. 440 Market St., San Francisco.
Northern Electric Co., Ltd., Canadian Distributors.

What Good's A Contract If You Can't Fill It?

No matter how long a man may take to decide, when he has signed up a lighting or power contract he wants immediate service. He'll cancel, too, if he doesn't get it. The best way to avoid unpleasant delay and possible loss of contracts is to keep on hand a few

PEERLESS TRANSFORMERS

Then you are equipped to deliver immediately and secure the customer's good will at the outset.

Fifteen years of satisfactory service have fully demonstrated the high efficiency, low core loss, low temperature rise and thorough insulation of Peerless Transformers.

Fully guaranteed for two years against mechanical or electrical defects—even against lightning.

Write today for catalog.

The Enterprise Electric Co., Warren, O. U. S. A.

AGENCIES

National Elec. Supply Co.....Washington, D. C.
The Northwestern Elec. Equip. Co.....St. Paul, Minn.
Erner Electric Co.....Cleveland, Ohio
J. G. Schaff Electric Co.....Chambersburg, Pa.
Maydwell Co.....San Francisco, Cal.
James M. Cory.....50 Church St., New York
John McC. Price Co.....Pittsburg, Pa.
John A. Savage & Co.....Denver, Colo.

1

One Generator on the Line—and That Afire!

Consternation — confusion — hurrying and scurrying — reigns, unless Pyrene is at hand.

Pyrene

Meets the Emergency

A shot or two of Pyrene at the burning machine stays the destructive arcs, while the swift manipulation of switches cuts in another unit and "kills" the machine endangered. *Pyrene* at times is the best assistant your operators can have.

Pyrene Manufacturing Co., 1358 B'way, N.Y.

Aberdeen, S. D.	Charlotte, N. C.	Duluth	Philadelphia
Alton	Charleston, W. Va.	Fargo, N. D.	Phoenix
Anderson, S. C.	Chicago	Jacksonville	Pittsburgh
Atlanta	Cincinnati	Louisville	Richmond
Baltimore	Cleveland	Memphis	St. Louis
Birmingham	Dayton	Milwaukee	St. Paul
Boston	Denver	New Orleans	Salt Lake City
Bridgeport	Detroit	Oklahoma City	San Antonio
Buffalo			York, Neb.

DISTRIBUTORS TO ELECTRICAL TRADE: WESTERN ELECTRIC CO.
PACIFIC COAST DISTRIBUTORS: GORHAM FIRE APPARATUS CO., San Francisco, Los Angeles, Seattle.
Distributors for Canada: May-Oatway Fire Alarms, Ltd., Winnipeg, Toronto.
Distributors for Great Britain and the Continent: The Pyrene Co., Ltd., 19-21 Great Queen St., London, W. C.

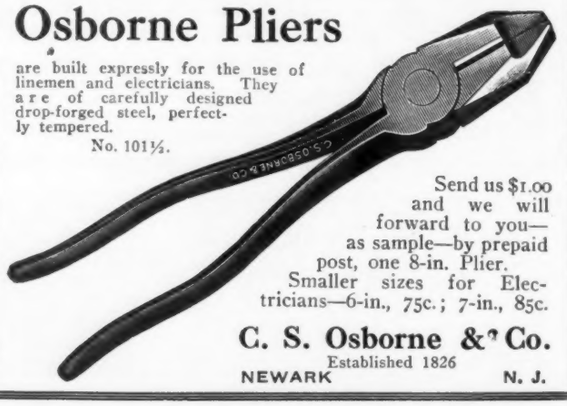
71626

Little "WANT" cards bring big results in the Electrical World

Osborne Pliers

are built expressly for the use of linemen and electricians. They are of carefully designed drop-forged steel, perfectly tempered.

No. 101½.



Send us $1.00 and we will forward to you—as sample—by prepaid post, one 8-in. Plier. Smaller sizes for Electricians—6-in., 75c.; 7-in., 85c.

C. S. Osborne & Co.
Established 1826
NEWARK N. J.

ELECTRIC CABLE CO.

17 Battery Place - - - - - - New York

RUBBER COVERED WIRE

"Invincible" "Engineers," 30% Para or to any specification

Works: BRIDGEPORT, CONN.

Offices, Boston, Philadelphia, Cleveland, Chicago, San Francisco

PLATINUM

Scrap Purchased

CONTACTS OF ALL FORMS
WIRE FOR WIRELESS TELEGRAPHY
RESISTANCE WIRE
WIRE AND SHEET FOR ALL PURPOSES

AMERICAN PLATINUM WORKS
NEWARK, N. J.

HARD PORCELAIN

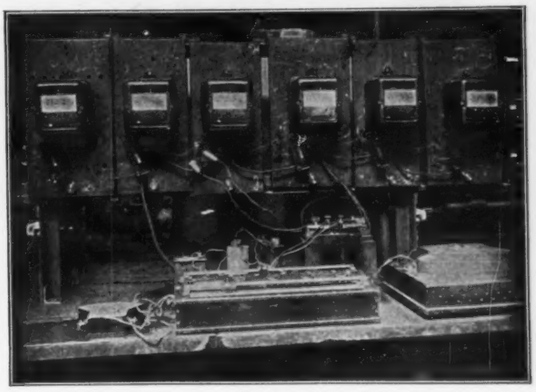
For Electrical Specialties

IMPERIAL PORCELAIN WORKS
TRENTON, N. J.

Try World "Positions Wanted" columns for high grade assistants.

Try World "Positions Vacant" columns for high grade positions.

Get your Wants into the Searchlight



Electrical Instruments and Meters

We calibrate, check and issue certificates of accuracy of

D. C. Ammeters up to 10,000 Amperes.
D. C. Voltmeters up to 10,000 Volts.
A. C. Ammeters up to 5,000 Amperes.
A. C. Voltmeters up to 50,000 Volts.
A. C. Integrating Wattmeters up to 10,000 Amperes.
D. C. Integrating Wattmeters up to 5,000 Amperes.

Also precision checks on standard Indicating Instruments, Standard Cells, Resistances, etc.

Electrical Testing Laboratories, Inc.
80th Street and East End Avenue
New York, N. Y.

WARD LEONARD

Resistors

Twenty years of Service has not affected our resistors because our vitreous enamel insulation is absolutely moisture-proof.

The ohmic resistance of the unit is constant at all temperatures, for the temperature coefficient of the wire used is zero.

Terminals

Standard terminals consist of flexible braid copper wire. Any type of terminal can be furnished—and units can be furnished for any desired mounting.

All sizes to meet space conditions. Any Resistor that may be desired.

Ward Leonard Elec. Co.
Bronxville, N. Y.

STORAGE BATTERIES AND ACCESSORIES OF EVERY DESCRIPTION

The "Reliance," The "Reliable," The "Hudson-Fulton" Batteries, Hydrometer Syringes, Hydrometers, Thermometers, Etc.

THE STORAGE BATTERY SUPPLY CO.
237 EAST 27TH STREET, NEW YORK CITY

Nungesser

Remember this name when you need

Carbon Brushes

We specialize in the higher grades
Full data on request

The Nungesser Carbon & Battery Co., Cleveland

HESS-BRIGHT BALL BEARINGS

FOR MOTORS REDUCE THE COST OF UP-KEEP

THE HESS-BRIGHT MANUFACTURING COMPANY
Front Street & Erie Avenue Philadelphia, Pa.

Special
Blanking, Trimming, Piercing & Forming
DIE WORK
Solicited
The Columbus Die, Tool & Machine Company
Columbus, Ohio

COMMUTATOR INSURANCE

THAT'S WHAT WE OFFER, FOR THERE'S NO FRICTION OR WEAR WITH THESE FIBRE GRAPHITE BRUSHES.

BEING 80 PER CENT. PURE GRAPHITE INSURES LOW RESISTANCE, NO SPARKING UNDER VARYING LOAD, LONGER WEAR AND NO GREASING.

HOLMES FIBRE-GRAPHITE MFG. CO.
GERMANTOWN, PHILADELPHIA, PA.

AMERICAN SHEET & TIN PLATE CO. APOLLO SPECIAL ELECTRICAL TRADE MARK REGISTERED PITTSBURGH

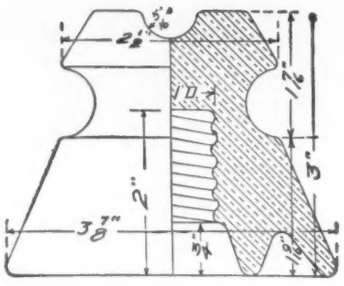
ELECTRICAL SHEETS

AMERICAN SHEET & TIN PLATE CO. U.S. ELECTRICAL TRADE MARK REGISTERED PITTSBURGH

APOLLO SPECIAL ELECTRICAL—Highest grade Electrical Sheets manufactured. Other standard sheets are U. S. Electrical, Dynamo Special, American Armature and Pole Face. Write for full information on Electrical Sheets, Apollo Best Bloom Galvanized Sheets, Black Sheets, Tin Plates, Etc.

AMERICAN SHEET AND TIN PLATE COMPANY, Frick Building, Pittsburgh, Pa.

Thomas Insulator
No. 1010



Line Voltage 5,000
Dry Test Voltage 20,000
Rain Test Voltage 12,000

Our Catalogue No. 12 sent on request.

The R. Thomas & Sons Co.

Established 1873 Incorporated 1892

Main Office, EAST LIVERPOOL, O.

FACTORIES:
East Liverpool, O.
Lisbon, O.

SALES OFFICES:
61 Broadway, New York
1290 Old Colony Bldg., Chicago

5

Realflex

Armored Conductor

is at its best in wiring finished or old buildings, because of its wonderful flexibility. You can wire an old building quickly and satisfactorily without tearing out the walls, partitions or joists.

"REALFLEX" should be used wherever high grade, safe and economical results are wanted at low first cost.

The Western Conduit Co.
Youngstown, Ohio.
Subsidiary to
The Youngstown Sheet & Tube Co.

SPRINGS
Good Ones

You can rely upon them—we watch the material, the work—and test the product. We make all kinds of good Springs.

Steel Fishing Snake for Electrical and Conduit Work.

See our Booklet.

Cary Spring Works
240-242 W. 29th St.
NEW YORK

3

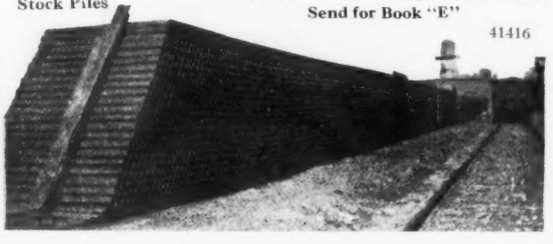
Orders for Standard Sizes of ORANGEBURG Fibre Conduit Filled within 3 Days!

THE FIBRE CONDUIT COMPANY
ORANGEBURG, N. Y.
New York Boston Chicago San Francisco

One of our Stock Piles

Send for Book "E"

41416



ANY SIZE OR MATERIAL
COOK SPRING CO.
106th STREET and EAST RIVER, NEW YORK

Anderson Switches and Switching Devices
for Central Stations

Albert & J. M. Anderson Mfg. Co.
289-293 A STREET BOSTON, MASS. 1

SAMSON SPOT CORD

FOR HANGING ARC LAMPS
SOLID BRAIDED COTTON—WATER PROOFED
Send for Catalogue and Samples.
SAMSON CORDAGE WORKS, BOSTON, MASS.

Try World "Positions Wanted" columns for high grade assistants.

Try World "Positions Vacant" columns for high grade positions.

Get your Wants into the Searchlight

I am S. N. Baruch the inventor of the Thermo Relay and this check is for anyone who can burn out a motor properly protected by Thermo Relays.

THERMO-RELAY Protection is REAL Protection—yet Affords full Advantage of Overload Capacity

The Thermo-Relay watches the *temperature* of your motor. The instant it gets *dangerously* hot—no matter what the current—the motor is *cut out*. The Thermo-relay works on the *heat*-limiting principle, and is an *absolute safeguard* under all possible operating conditions. Write for data.

Baruch Electric Controller Corporation
105 to 117 Kearny St., San Francisco, Cal.

AFTER

selecting the best possible apparatus for the power plant of the central station, such as engines, boilers, dynamos and switchboard, etc., the next thing in order is to choose the best meters and transformers obtainable, so that the outfit may represent a profitable combination—that is, one that will give the most reliable service to its patrons and be the most remunerative to the stockholders. Duncan Meters and Transformers fulfill these qualifications to a nicety.

We manufacture a full line of A.C. and D.C. Watthour Meters, also Transformers for any pressure up to and including 33,000 volts.

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, INDIANA

WESTERN CEDAR POLES
UNTREATED OR BUTT TREATED with CARBOLINEUM or CREOSOTE } 31 Yards
WESTERN LUMBER AND POLE CO.
Main Office: "Electric" Bldg., Denver, Colo.

From
POLE to POLE
You will find none better than
IDAHO CEDAR POLES
We produce in our own forests
Sound in Quality—Right in Price
Large Stocks—Quick Service
Sandpoint Lumber & Pole Co.
Sandpoint, Idaho

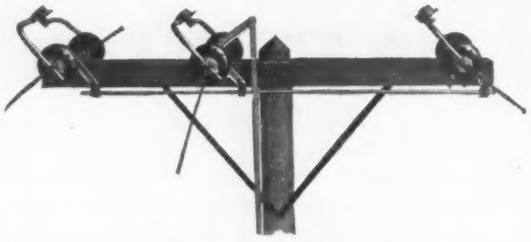
You Can Save Current With
Colonial Sign Letters
So designed as to reduce number and candle power of lamps, yet give a bright, sharp sign.
Ask for Booklet and prices
Colonial Sign and Insulator Co., Akron Ohio

Douglas Fir Cross-Arms
TREATED OR UNTREATED
QUICK SHIPMENT — Strictly independent manufacturers. Can furnish high-grade Cross-Arms, any dimension, at prices that make it worth your while to write or wire. — RIGHT PRICES
BARNES-LINDSLEY MFG. CO., PORTLAND, ORE.
For Cedar Poles, Write Lindsley Bros., Spokane, Wash.

Custom Made Transformers
For all voltages—For every usage
AMERICAN TRANSFORMER COMPANY
149 Miller St.
Newark, N. J.

IDLE MACHINERY
will soon lose its value. Place an advertisement in the "Searchlight Section" of the ELECTRICAL WORLD and
Sell, Rent or Exchange
it for something for which you may have immediate use. The cost will be slight. Let us mail you a rate card.
ELECTRICAL WORLD 239 West 39th Street New York

BAKELITE-DILECTO
WATERPROOF PERMANENT STRONG
A laminated *Insulating* material of highest efficiency. Also
VULCANIZED FIBRE
In Sheets—Rods—Tubes—Special Shapes.
THE CONTINENTAL FIBRE CO. Newark, Delaware
CHICAGO, McCormick Bldg. NEW YORK, Woolworth Bldg.



Make Any Pole a Self-Contained Unit

by sectionalizing your high-tension line with the

K-P-F Pole-Top Switch

This is a practical, strong, efficient disconnecting switch for sectionalizing high voltage transmission lines.

It is of the utmost simplicity in principle and construction.

The same insulators which dead-end your wires hold the switch contacts.

Installation reduces labor and material cost to a minimum.

The switch may be locked in either open or closed position.

Shipped ready for bolting to cross arm.

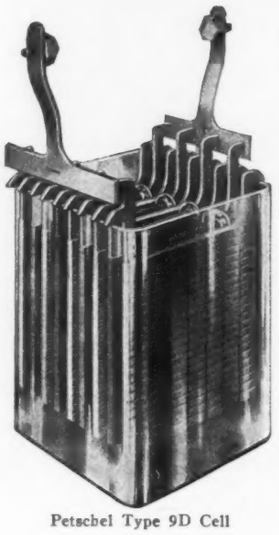
Bulletin 102 describes the K-P-F Switch in detail. Write for it.

K-P-F Electric Co.
37 Stevenson Street, San Francisco, Cal.

8345 2

A newly discovered method of making the plates is responsible for the long life of the

PETSCHEL Storage Battery



Petschel Type 9D Cell

For its great increase of ampere hours over any other battery of the same weight and size.

For its greater ability to maintain a high voltage during a heavy discharge.

Other advantages are described in catalog A and bulletin 21, which may be had for the asking.

Petschel Storage Battery Co., Inc.
3051 W. Lake Street, Chicago

5

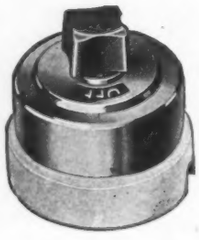
MESCO

Snap Switch

125-250 Volts—N. E. C. Standard

A New Member of the

"Mesco Products" Family



Get Acquainted. You will not regret it.

Manhattan Electrical Supply Co.

New York	Chicago	St. Louis	San Francisco
17 Park Place	114 S. 5th Ave.	1106 Pine Street	604 Mission Street

Factories: Jersey City, Cincinnati, Ravenna, O.

HEMMING INSULATION
GUMMON (EG) HEMIT

STANDARD

Heat-Resisting Molded Insulation. Made by specialists exclusively devoted to solving your molding problems.

Why not profit by our experience

HEMMING MANUFACTURING CO.
GARFIELD, NEW JERSEY

HIGH GRADE SPRINGS

Of every description from flat stock or wire. Special attention paid to accuracy and temper. Prices quoted upon receipt of samples.

Ask for Booklet 6-C.
Established 1857

THE WALLACE BARNES CO.
Main and Parallel Streets, Bristol, Conn.

Mfrs. of Small Springs of every description, Screw Machine Products, Spring Washers, Stampings, etc. Dealers in Spring Steel and Wire.

PLATINUM

IN ALL FORMS—FOR ALL PURPOSES
SCRAP PURCHASED

The Roessler & Hasslacher Chem. Co.
New York Office: 100 William St. Factory: Perth Amboy, N. J.

STERLING PRODUCTS

SWITCHBOARDS—PANEL BOARDS
KNIFE SWITCHES—IRON BOXES

STERLING SWITCHBOARD CO.
537-545 SO. 7th STREET, CAMDEN, N. J.

Simply Press Down Spring, Insert Wire and Let Go
That's why you should insist on having

FAHNESTOCK
SPRING BINDING POSTS

Press Down Here.

on all the electrical devices you buy (without extra charge) and why manufacturers put them on their products (gratis).

One of many

FAHNESTOCK ELECTRIC COMPANY
129 Patchen Avenue Brooklyn, N. Y.

"Pittsburg"

High Voltage

Porcelain Insulators

Are doing real service all over the world on telephone, telegraph, and power transmission lines. They put the finishing touch to a first-class line because their design is right. Made in all styles of the most perfect quality porcelain. Furnished with a beautiful mahogany color glaze or any color desired.

Send us your requirements.

The Pittsburg High Voltage Insulator Co.

Main Office and Factory: DERRY, PA.
New York Office: 114 LIBERTY ST.
Chicago: 320 New York Life Bldg.
Los Angeles Office: 757 S. Los Angeles St.
San Francisco Office: 247 Minna St.
Portland, Ore.: 343-5 Oak St.
Seattle, Wash.: 560 First Ave., South.
Canadian Representative: The Canadian General Elec. Co., Toronto, Ont., Canada. 1

The biggest success

so far achieved by high potential

Insulators:

See the teats on the petticoat

Height 3¾ in.
Diameter 4¾ in.

No. 71—10,000 Volts.

The teats on the petticoat attract water on the outer and inner surfaces into drops, preventing creeping of moisture, on insulators and pins.

The line's complete *Catalog tells all.*

HEMINGRAY GLASS CO.

General Office: Covington, Ky. Factory: Muncie, Ind.

G. M. Gest

Conduit

Engineer & Contractor

Executive Offices
Woolworth Bldg.
New York

Cincinnati *San Francisco* *Montreal*

Pelton-Francis Turbines

Retain all the good features of the well known Francis type turbine, and in addition introduce a number of entirely new features effecting closer regulation and greater water economy.

Do these features interest you? If so, let us explain in detail these new features.

The Pelton Water Wheel Company

91 West St., New York, N. Y.
2231 Harrison St., San Francisco, Cal. 2

The Benjamin Attachment Plug

"That Swivel Shell Makes The 9—0—3 Sell"

Cat. No. 9—0—3

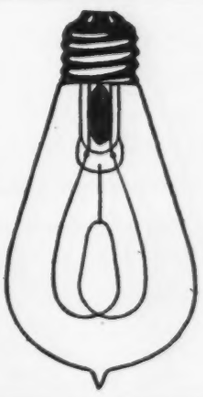
BENJAMIN ELECTRIC MFG. CO. 1
New York Chicago San Francisco

FOR AUTOMATIC MOTOR STARTERS, LIFTING MAGNETS, CONTROLLERS, ETC.

CONSULT

THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, O.



PURCHASES
POSSESS
PROFITS
WHEN
PLACED
WITH

Consolidated Electric Lamp Company
Tapleyville Station,
Danvers, Mass.

This is the new and improved type M-900 transmitter used in conjunction with

Hopkins Electric Tachometer Systems

It can be calibrated with any standard make of recording or indicating millivolt meter, forming the most sensitive, accurate and reliable tachometer obtainable. Scales of the instruments can be marked to read R. P. M., Capacity, or Frequency.

Our type M-900 transmitter is full ball bearing and is designed for constant service for installation on turbines, motor generators, high speed pumps, presses, centrifugal separators, etc.

Instruments can be furnished to indicate or record or both. One or more instruments may be paralleled from one transmitter and placed at the most desirable points for observation.

Our bulletin No. 100W tells more about this perfected system of speed measurement.

ELECTRIC TACHOMETER COMPANY
General Offices, Perry Building
Works, 435 N. Broad Street Philadelphia, Penn

Keystone Ammeters and Voltmeters

A complete line of the highest grade Electrical measuring instruments, ranging in size from 3" up. Send for complete catalogue.

Keystone Electrical Instrument Co.
Philadelphia, Pa.

New York Pittsburgh Chicago
4

It Would Be Almost a Miracle

if one or more of the 20,000 men who regularly receive the World did not happen to want that used machinery which you want to sell. The

Searchlight Section

brings buyers and sellers together.

Copy received until Wednesday noon for publication in the issue of that week.

"THESCO"
Vertical Wire Clamps

will fasten any conductor, up to 1¼" diameter to any ordinary sized insulator. And they won't break the insulators either—the single bolt takes care of that.

Write for particulars and prices.

The States Company
19 New Park Av., Hartford, Conn.
1

Accurate, Compact, Inexpensive
VOLTMETERS, AMMETERS and VOLT-AMMETERS
Send for complete catalog
LOUIS M. PIGNOLET
78 Cortlandt Street New York

Hoyt Electrical Instrument Works, makers of Hoyt Ammeters and Voltmeters, Penacook, New Hampshire.

TRUE AS STEEL
LAVITE Insulation
Machined in any form as accurately as steel. Stands any heat
Specimen and Booklet on Request. 2
D. M. STEWARD MFG. CO., Chattanooga, Tenn.

Over Half the Readers
of the advertising pages depend upon illustrations to attract them. Are your advertisements "attractive"?

Entirely Exhausted

The editions of

October 17 and November 7
of Electrical World

are completely sold out

We need copies of these issues for binding, etc., and will pay 15 cents each for copies delivered at our New York office or mailed to us postpaid.

Mark wrapper with your name and address and mail to

Circulation Department

Electrical World
239 West 39th Street
New York

Tungsten Posts

For Street Lighting

ARC LAMP POLES, BRACKETS

Ornamental Lighting Posts for all purposes. We have just what you require among our thousand different models.

We manufacture all posts used for N. Y. City lighting.

Catalogues and special designs on application.

Correspondence solicited

The J. L. Mott Iron Works
118-120 Fifth Ave., New York City

"CEAG" Electric Lamp—the Lamp of Safety

Over 125,000 "Ceag" Lamps in continuous use all over the world.

The safest, strongest, cheapest, and most reliable Electric Safety Lamp for use in

Dangerous Working Places

Guaranteed low maintenance cost and most simple to operate.

FIRST PRIZE from the British Home Office in a competition out of 197 lamps submitted.
FIRST PRIZE and GOLD MEDAL World's Exposition of Ghent 1913.
FIRST PORTABLE HAND LAMP approved by U. S. Bureau of Mines.

Write for particulars
CONCORDIA SAFETY LAMP COMPANY
Manufacturers' Bldg. Pittsburgh, Pa.

Tell about
that equipment
in our Searchlight Section

Tell what you have to sell. Tell what a bargain it is. Tell the men who **want** it. the details that will interest them.

The readers of this paper are buying and selling thousands of dollars' worth of second-hand equipment every day.

Get *your* Wants into the Searchlight.

Electrical World, 239 W. 39th St., New York City

PLAIN AND ORNAMENTAL LIGHTING POLES
Of Every Description
Catalog "W" Mailed on request.
Electric Railway Equipment Company
N. Y. Office—30 Church Street Cincinnati, Ohio
See our large "ad" in last issue of the "World"

WHITE WAY POLES
MANY DESIGNS AND PRICES RIGHT

WRITE FOR CATALOGUE
KING FOUNDRY COMPANY
ST. JOSEPH, MO.

INNER ARC GLOBES
INCANDESCENT BULBS, TUBING & CANE
Write for Prices. The Lippincott Glass Co., Alexandria, Ind.

Clock removable from here to wind and set.
Supports allow space back of switch for wires.
Switch set by movement of lever to this position.
Iron Cover removable for wire connections.
Switch may be manually operated by this button independent of time switch mechanism.

$5.00 For a Short Time Only

Sent by Parcel Post at the above price for cash with order, one of these Automatic Electric Time Switches.

Campbell Elec. Co.

LYNN, MASS.

ONE-DAY TIME SWITCH
Type "A"

Stocked by Principal Jobbers

Save the Heat

in your Exhaust Steam by use of

"MICHIGAN" Steam Pipe Casings

for Insulating Underground Steam Heating Pipe,

and turn it into revenue instead of letting it go to waste. Big Central Stations all over the country are doing this, and find Michigan Pipe Casings indispensable. Michigan Pipe Casing is absolutely waterproof —it is tin-lined to prevent radiation and is built of the most effective non-conducting materials. *A word from you will bring particulars and prices—write!*

The Michigan Pipe Co.
Bay City, Mich.

Also Manufacturers of MICHIGAN Combination Steel and Wood Water Pipe for Conveying Water in Connection with Hydroelectric Plants.

You Never Saw A Socket Built Like This Unless You Have Seen The

OSTRANDER

Pull Chain Socket.
Built For Those Who Want The Best.

THE ONE BIG FORWARD STEP IN
Socket Construction.

Write for Special Circular 26 T.

W. R. OSTRANDER & CO.
22 DEY STREET NEW YORK

PUBLIC SERVICE

can best be advanced by serving the public with something it will appreciate. The people are sure to be pleased with a utility which does good work, is convenient and costs them a moderate price.

THE AUTOMATIC

fills the bill. Its convenience pleases the women. They can wash and wring at the same time; also operate ironing machine by attaching the Universal Rod to the wringer shaft—or the churn, ice cream freezer, food chopper, etc.; they can drain the water without tilting tub. All these things are illustrated and explained, with much valuable information, in a splendid new book, 32 pages in colors. Just ask for **Bulletin 77.** We shall gladly send it.

Automatic Electric Washer Co., Inc., Newton, Iowa

Member of Society for Electrical Development. Do it Electrically

4

Eureka Moulded Fibre Battery Boxes Will Often Save Their Cost

in wire needlessly run to an arbitrarily-placed battery. They are so neat that they can be installed wherever convenient, and give effective protection to the battery. Cost no more than wood boxes. Write for prices and particulars.

EUREKA SUPPLY CO. SEWELL NEW JERSEY 3

Member Society for Electrical Development—"Do it Electrically"

Pocket Voltmeters, Ammeters, Volt-Ammeters

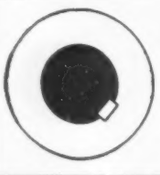
Lamp Testers, Miniature Switchboard Instruments.

Eldredge Electric Mfg. Co.
103 P. O. Square, Springfield, Massachusetts 2

Can't Separate in the Conduit
COPE CONDUIT RODS

Ask for the details of Cope Cable Rack and Conduit Threading Machine.

T. J. COPE, 3244 N. 15th St., Philadelphia



Crocker-Wheeler Co.
Motors, Generators, etc.
FACTORY: AMPERE, N. J.

NAME PLATES

METER AND CLOCK DIALS

Premier Metal Etching Co.

617-625 EAST 18TH ST., NEW YORK.

Crescent Coloring Fluid and Lamp Frosting

Imparts a snap and brilliance to lamp bulbs usually found only in natural colored glass. Satisfactory results guaranteed. Furnished in following colors: Blue, green, purple, amber, red, ruby, violet, canary, pink and frosting.

McGill Manufacturing Company
VALPARAISO, IND.

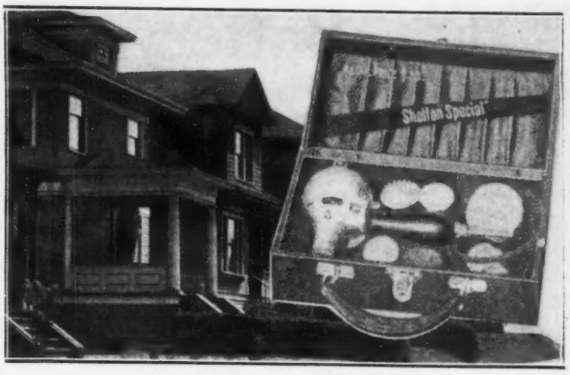
8674

INTER-POLE MOTORS

For all electric drives. Constant or adjustable speed. Freedom from sparking. It's due to the INTER-POLES.

Bulletins mailed on request.

Electro-Dynamic Co., Bayonne, N. J.



More Lighting Contracts

are secured when the Central Station makes a complete display of current using devices. They weigh heavily in deciding whether or not a house shall be wired. Make

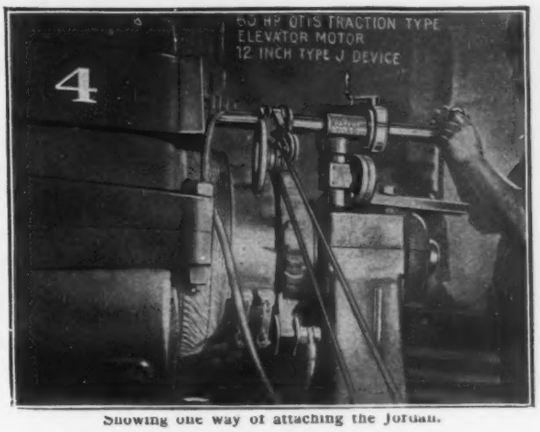
THE SHELTON LINE

a part of your sales-building equipment. It includes Vibrators, Hair Dryers, Massage Apparatus, Drink Mixers and Vacuum Cleaners.

Our Advertising Campaign is Creating a Demand

and our proposition is a liberal one, sure to take well in your territory. Ask for complete catalog and Central Station proposition.

SHELTON ELECTRIC COMPANY,
New York, Chicago, Boston
62 Post Street, San Francisco, Cal. 2



Showing one way of attaching the Jordan.

"Its use a single time is really worth the price"—
Storm Lake Elec. Lt. & Power Co., Storm Lake, Iowa.

The JORDAN Commutator Truing Device

The Jordan *seemed* like "quite an investment" to these people—but now they are enthusiastic. It's not what *we* say of this device, but the user's opinion that counts. Glad to send you further names, Catalog (No. 3) and prices. Just write.

Are you going to find out why?

JORDAN BROS., Inc., 80 Beekman St., N. Y. City
41212 1

For All Installations Where

CARBON LAMPS

are used, the Renewed Types made by us will prove the best purchase.

Send orders to

Boston-Economy Lamp Division
National Lamp Works of General Electric Co.
128 MAPLE ST. DANVERS, MASS.

All the best steam vessels, yachts and launches use our

ELECTRIC SEARCH LIGHT PROJECTORS

Meet all requirements of commercial and government service.

SEND FOR CATALOG A

The Carlisle & Finch Co.
228 E. Clifton Avenue
CINCINNATI, OHIO 2

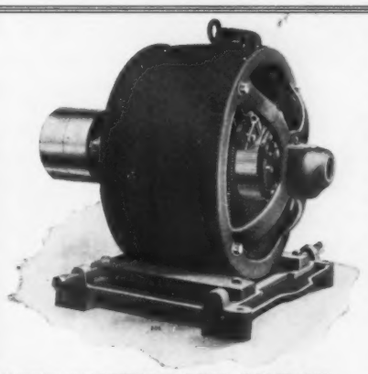
Real Motors for Toys

Emerson 1/30 and 1/20 hp. A.C. and D.C. Power Motors are ideal for operating mechanical toys.

They run off lighting circuits —why buy batteries?

Prices are not high. Ask us!

The Emerson Electric Mfg. Co.
2032 Washington Ave., St. Louis, Mo.
50 Church St., New York City



Diehl Type G Direct Current Motors are standardized throughout a wide range of ratings. They are delivered from stock upon occasion and necessitate no delays or special construction to fulfill the requirements of any branch of power service to which a standardized form of motor can be applied.

Send for Bulletin No. 104.

DIEHL MANUFACTURING COMPANY, ELIZABETH, N. J.
Branches: New York, Chicago, Boston, Philadelphia, Washington, D. C., Williamsport, Pa.

The "Ironclad-Exide" Battery
FOR ELECTRIC VEHICLES

Reliable day-in and day-out—every day in the year. No delays—no fuss—no inconvenience. Always dependable. The battery for big loads—rough or hilly roads—hard service. Economical to use—economical to maintain. Good when new and stays good.

THE ELECTRIC STORAGE BATTERY CO.

New York Boston Chicago Denver **PHILADELPHIA, PA.** San Francisco Seattle St. Louis
Cleveland Atlanta Detroit Washington Pittsburg 1888-1914 Rochester Los Angeles Portland, Ore. Toronto

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All of this may be avoided if you use

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

It will put that high gloss on the commutator you have so long sought after

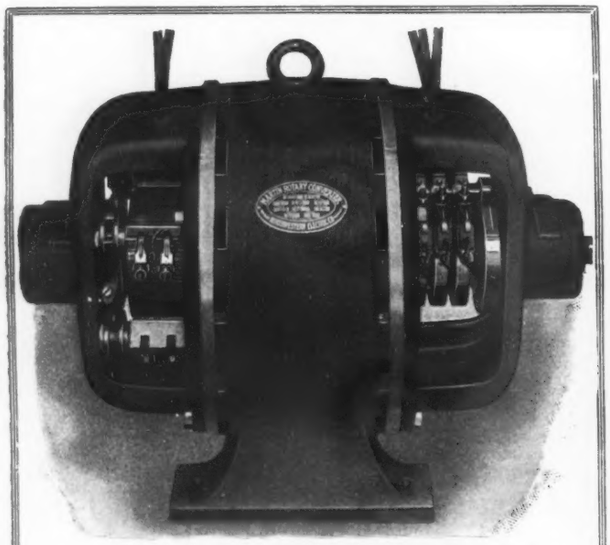
Send for Stick **50c PER STICK** **$5.00 PER DOZ.**

For Sale by all Supply Houses, or **K. McLennan & Co.** Sole Manufacturers
412 So. Fifth Ave., CHICAGO

Mr. Carnegie's Success

is, by himself, largely attributed to his fortunate choice of business associates and assistants. ELECTRICAL WORLD "Positions Vacant" and "Positions Wanted" columns bring together the man and the place.

Get your Wants into the Searchlight



MARTIN
Rotary Converter

for charging Storage Batteries under the constant Potential Method

Write for full particulars

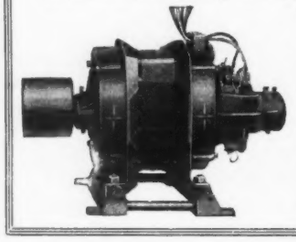
Northwestern Electric Co.
611-615 W. Adams St., Chicago, Ill.

For Running Printing Presses

KIMBLE A-C MOTORS
Single Phase Variable Speed

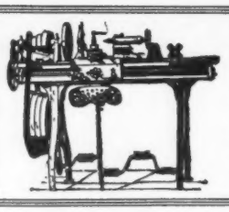
Increase the efficiency of each press fully 25% over line shaft drive—and at least 20% over ordinary A. C. motor drive. Reduce current in direct proportion to press speed reduction.

Every Kimble Motor you sell means a happy printer — and there's liberal profit in it for *you*.



Write for Red Catalog and prices.

Kimble Electric Company
The Alternating Current Motor Specialists.
637 N. Western Ave., Chicago, Ill



LATHES 9 to 13 inch Swing for Foot or Steam Power.

No. 4½	Lathe,	9 x 25	List $75.00
No. 5	"	11 x 34	" 100.00
No. 5½	"	13 x 33	" 135.00
No. 13	"	13 x 33	" 162.00

The No. 13 Lathe has automatic cross feed and compound rest. Beds made 5 to 10 feet long.

SEND FOR LATHE CATALOG.
W. F. & Jno. Barnes Co.
216 Ruby Street, Rockford, Ill.

BOND ISSUES

should always be advertised in the WORLD as a direct and economical method of reaching the financial people interested in public utility issues who read regularly the ELECTRICAL WORLD for industrial and financial information. All "Proposals," $2.40 an inch.

ELECTRICAL WORLD, 239 West 39th Street, New YORK

STACKPOLE

FOR QUICK
DELIVERY
of
EFFICIENT

CARBON BRUSHES

GET IN TOUCH
WITH
STACKPOLE SERVICE

STACKPOLE CARBON CO.

ST. MARYS, PA.

193 William St., N. Y.

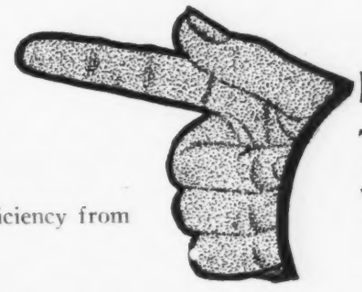
1

THIS BULLETIN 107 is free on your request. You will be a better posted electrical man if ou get it and read it.

BURKE ELECTRIC CO. Principal Office and Works ERIE, PA 1

LE CARBONE—

The brush of unvarying quality.
The brush that eliminates commutator wear and trouble.
The brush that gives the longest life.
The brush that enables you to obtain the highest efficiency from your equipment.
NOW is the time to try them.



Here's The Brush You Want

174 FULTON STREET **W. J. JEANDRON** **NEW YORK CITY**

SCALE AND ECONOMY CANNOT EXIST IN THE SAME BOILER PLANT

Enter Scale—Exit Economy

As soon as scale forms on the heating surfaces, efficiency decreases, and coal bills increase. In fact, you can get as much work out of a small boiler that is clean as you can out of a large boiler with scale filled tubes.

Economy means *continually clean* boilers—and this can be accomplished only by *continuous treatment* of the water with *proper reagents. This is the Dearborn Method.*

DEARBORN CHEMICAL COMPANY, McCORMICK BUILDING, CHICAGO

BRANCHES
Atlanta
Boston
Chicago
Cincinnati
Cleveland
Denver
Havana, Cuba
Los Angeles

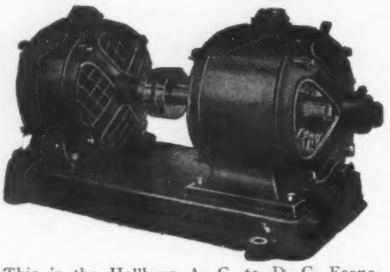
THE BABCOCK & WILCOX COMPANY

85 Liberty Street, New York

WATER TUBE BOILERS
Steam Superheaters **Mechanical Stokers**

BRANCHES
New Orleans
Philadelphia
Pittsburgh
Portland, Ore.
Salt Lake City
San Francisco
Seattle

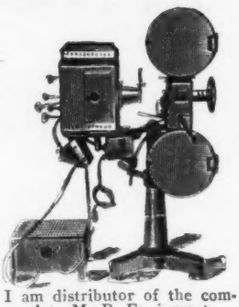
Central Station Managers and Electrical Contractors



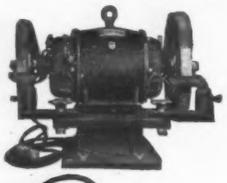
This is the Hallberg A. C. to D. C. Economizer—It is *not* an ordinary motor generator; it saves 25 per cent more on the bill.

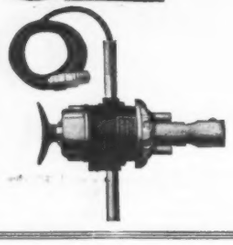
When you have trouble with your consumers and customers about electric bills and the quality of light produced for motion picture theatres, CALL UPON "HALLBERG" for suggestions and the cost of overcoming these difficulties. I have had many years experience in projector arc lighting and can be of considerable service to you. Write today for catalog, but specify Dept. E.

J. H. HALLBERG
36 East 23rd Street, New York, U. S. A.



I am distributor of the complete M. P. Equipment.





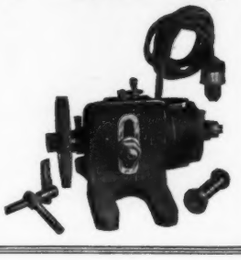
Every Machine Shop and Garage Is a Profitable Prospect

for the Central Station man who will put a little time into selling

U. S. ELECTRIC DRILLS AND GRINDERS

Drills for drilling metal, in sizes from ¼" to 1¼".
Centre Grinders for treeing lathe centres, sharpening cutters and dies or for general grinding on lathe, shaper or planer.
Bench Grinders for tool sharpening or general grinding or polishing. Made in six sizes, from ¼ H.P. to 5 H.P.
The first move toward "starting something" is to write for detailed information and prices. Do it now.

The United States Electrical Tool Co. Cincinnati, Ohio
New York Office, 50 Church St. Chicago Office, 9 So. Clinton St.
Boston Office, 12 Pearl St. St. Louis Office, 614 Victoria Bldg.



CARPENTER'S TOOLS
Cut Threads Accurately

Tap or die, they can be depended upon for accurate, smooth, clean threads.
We are prepared to furnish Machine Screw Taps and Dies to the New Standard adopted by the American Society of Mechanical Engineers.

TRADE MARK C Registered

J. M. Carpenter Tap & Die Co.
Pawtucket, R. I., U. S. A.

FOREIGN REPRESENTATIVES:
Alfred Herbert, Ltd. (Coventry, England), Great Britain.
Schuchardt & Schutte—Berlin, Shanghai, Vienna, Stockholm, Tokio, Budapest, Copenhagen, St. Petersburg.
Alfred H. Schutte—Cologne, Brussels, Liege, Paris, Milan, Bilbao, Barcelona 2

You may dampen or spatter this Eck if you will.

But the motor will carry loads perfectly still.

It's the motor for locations laden with dampness or dust—metal, wood, wool, etc.

ECK ENCLOSED MOTORS

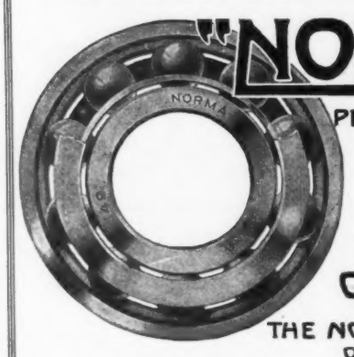
are preeminently adapted for work under unfavorable conditions. ¼ to 10 H.P.

They are fully described and listed in the Eck Data Book. Bulletin No. 40.

ECK DYNAMO & MOTOR CO.
BELLEVILLE, N. J. 3

Card Index ELECTRICAL WORLD, DEC. 12, 1914 Vol. 64

Business and the President	1129
Special Electric-Service Contracts	1129
Partial Destruction of Edison Plant	1132
Supply Jobbers at Birmingham	1133
Cheaper House Wiring. By W. H. Blood, Jr	1134
N. E. L. A. Wiring Committee Meeting	1134
Electrical Graduates in 1914	1135
Street-Lighting Tables for 1915	1135
Large Contract of Worcester Company	1136
New York Company to Furnish Energy for N. Y., N. H. & H. R. R.	1136
Centralization of London Energy Supply	1137
Investigation of United Gas Improvement Co	1138
Cleveland Municipal Plant Discussed	1139
Report of Secretary of Interior Lane	1140
Meeting of National Civic Federation	1140
Long Transmission Lines. By R. A. Philip	1147
Operating Features of the Audion. By E. H. Armstrong	1149
The Electron Theory and Metallic Selenium Crystals	1152
Valuation in Houston, Texas	1152
Purification of Milk by Electricity	1153
Liability of Electric Company Using Joint Poles	1154
Illumination with Gas-Filled Lamps	1157
Methods of Expressing Brightness. By J. R. Cravath	1157
Location of Reactors	1159



"NORMA"

PRECISION BEARINGS

BALL
ROLLER
THRUST
COMBINATION

THE NORMA COMPANY OF AMERICA
1790 BROADWAY NEW YORK

Century

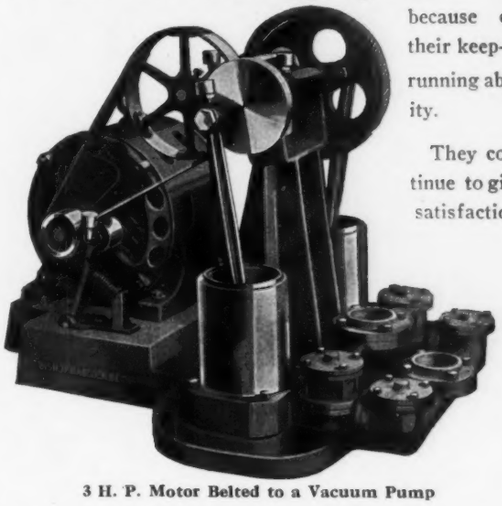
SINGLE PHASE MOTORS

have been selected by a large number of manufacturers of

Vacuum Heating Systems

because of their keep-a-running ability.

They continue to give satisfaction.



3 H. P. Motor Belted to a Vacuum Pump

Century Electric Company

19th, Olive to Pine Sts.
St. Louis, Mo.

New York Office
30 Church St.

Member Society for Electrical Development, "Do It Electrically"

123

ELECTRIC MACHINERY CO

MINNEAPOLIS E M MINNESOTA

Water Power Saved Is Profit

Your proposed electrical development of water power will yield a handsome profit if you *do it right* and use our *Vertical High Efficiency Alternator.* Don't install 200 horsepower in waterwheels with gears and belts to drive your generator, and obtain only 100 horsepower in electrical energy delivered. Install our *Frictionless Vertical Alternator* direct coupled to a vertical shaft waterwheel and save all losses between (which often amounts to one-half the capacity of the waterwheels).

We manufacture these *Vertical* Alternators in all sizes from 25 *K.W.* up and from 90 *R.P.M.* up. We also manufacture a complete line of belted and engine type alternators. *Write for Bulletin and Full Information.*

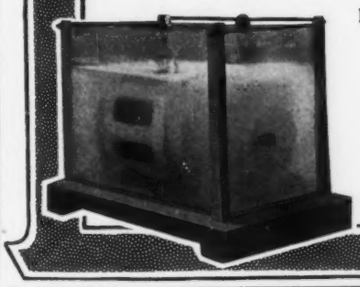
4

LINCOLN MOTORS

You don't expect to run your motor under water but there's a satisfaction in knowing that the insulation is good enough to stand the test.

This 3½ H.P. Lincoln Motor has been operating under water for two years without loss of efficiency.

Lincoln Electric Company



Kelley Ave. and 38th St.
Cleveland, Ohio

Chicago, Ill.
St. Louis, Mo.
Detroit, Mich.
Columbus, O.
Buffalo, N. Y.

1

Look Into This Armature

Before specifying a motor for that responsible drive. The C & C armature and commutator are hollow cylinders with open spiders. The inactive iron of the armature has been removed resulting in a 30 per cent increase of radiating surface.

The largely increased armature surface, combined with a large number of ventilating ducts and comparatively thin section of active material offer free natural ventilation and rapid dissipation of heat. As a result C & C motors have high overload capacity and a reliability which has made them a standard for important drives.

Over 40,000 C & C Motors are in daily operation.

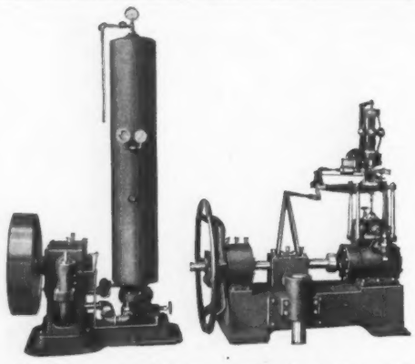
If you are interested in a motor of constant and reliable characteristics, ask for our Bulletin E-511-G.

C & C ELECTRIC & MFG. CO.

Main Office and Works:
Garwood, N. J.

New York Philadelphia Boston Chicago
Representatives in all Principal Cities.

67



58 used in electrification of New York State Erie and Barge Canal Installation.

YOU ARE LOOKING for the one water wheel governor which is better adapted to your requirements than any other. We have it. We build about forty different designs of governors. They are used in the largest water wheel installations in the world and in thousands of smaller ones.

WE ARE LOOKING for an opportunity to get in touch with you. May we have it?

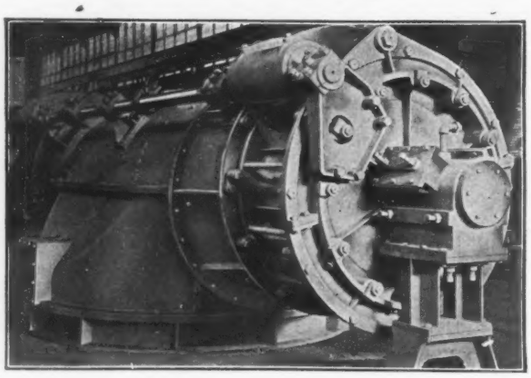
We will be glad to put you on our permanent mailing list

The Lombard Governor Co.

Works and Main Office, Ashland, Mass.

Branch—504 Candler Bldg., Atlanta.

West Coast Agents—Pierson, Roeding & Co., 118 New Montgomery St., San Francisco; 707 Spalding Bldg., Portland, Ore.; 523 Colman Bldg., Seattle, Wash.



Samson Hydraulic Turbines

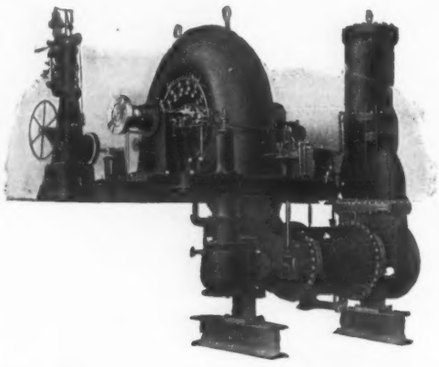
3,000 Horse Power

This illustrates one of two units installed for the Virginia Passenger & Power Co., Richmond, Va. Each unit consists of SAMSON horizontal shaft turbines direct connected to generator. Head of water 25 feet, total capacity 3000 H. P. We would like the opportunity of bidding on your requirements in the way of turbines, as we are fully prepared to furnish the latest and best design of turbine work. Shall we send you a catalog?

JAMES LEFFEL & CO.

308 Lagonda Street, Springfield, Ohio, U. S. A.

3



Hydraulic Turbines

ENGRAVING REPRESENTS

One of Three Units

Each

1700 Horse Power, 720 R. P. M., 280 Ft. Head

Turbines designed to meet all requirements for heads from 5 to 600 feet

WRITE FOR BULLETIN W

S. MORGAN SMITH CO., York, Pa.

BRANCH OFFICES: 1

176 Federal Street, Boston, Mass. 644 American Trust Building, Chicago, Ill.

WATER WHEEL GOVERNORS

Our Governors successfully regulate several 4000-hp units where, many times a day the load is built up from zero to a 50 per cent overload within 5 seconds; and as frequently dropped completely in less than 1 second. The head is 200 ft. and supply is through a 12,000-ft. pipe line. Such service is assured with Ludlow Governors equipped with our high-power centrifugal head, patented operating valve and rugged construction. Governors for all makes of turbines, any size, kind of load, or operating head.

Ludlow Pipe Line Relief Valves. Two types, 12 sizes up to 60-in.

GOVERNOR DEPARTMENT
LUDLOW VALVE MANUFACTURING CO., Troy New York

BEST MANUFACTURING CO.

PITTSBURGH, PA.

Manufacture and Erect

Piping Systems for Central Stations

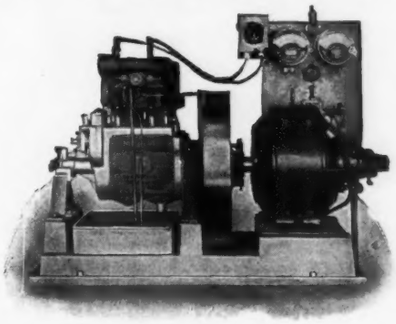
TRUMP TURBINES

All styles and designs built to suit your location. Send at once for our illustrated catalog.

THE TRUMP MFG. COMPANY

Columbia & Greenmount Aves., Springfield, Ohio

BRUSH ELECTRIC LIGHTING SETS



These plants are simple, reliable and economical; no expert attention is necessary.

For country residences, stores, moving picture shows, etc., etc.

Made in sizes Two, Four and Ten Kilowatts. Compact, self-contained; regulation perfect.

Send for catalogue and trade prices.

The Chas. A. Strelinger Co.
Box W-2, Detroit, Mich., U. S. A.

2

A Modern Governor for Modern Installations

While we have developed the oil pressure type of water wheel governor to a point where correct results and perfection of operation is absolutely assured, we have not neglected the matter of design. We have produced a number of different designs of

The Woodward Oil-Pressure Water Wheel Governor

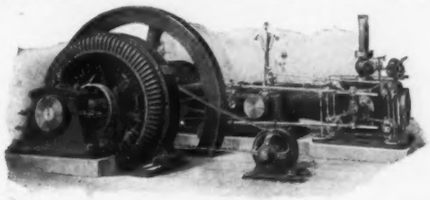
each particularly adapted to a certain style of turbine or installation. The design shown herewith is proving to be one of the most popular. It is adapted to all horizontal shaft installations where the gate shaft has a short travel. In most cases the governor shaft can be coupled direct to the gate shaft. In other cases the connection is made with levers and coupling links, thus securing the most direct transmission of the power of the governors to the gates. Governors of this design occupy the least possible floor space, and while all parts are accessible, the working parts are all enclosed and protected. The hand wheel device is efficient and easily engaged. There is a clutch to disconnect the power cylinder when operating by hand, and a brake to hold the gates in any desired position. There are many other desirable features described in our printed matter, which we will gladly send on request.

WOODWARD GOVERNOR CO.
202 Mill Street, Rockford, Ills.

2

What You Have Been Waiting For
50, 75 and 100 K. V. A. Generator and 150 R. P. M. Engine

1870



1914

An engine running at high speed that is really economical. A true Corliss Engine with 4 valves and releasing gear. A governor that actually governs. An engine type A.C. Generator in the smaller sizes. Everything of the latest design. Engine on exhibition in the Bourse, Philadelphia.

Murray Iron Works Co., Inc. Feb. 1, 1870 **Burlington, Ia.**

MOVING GRATES

THE RILEY
Self-Dumping Underfeed
STOKER

Send for Booklet W

is the only underfeed stoker that can break up clinker as fast as it forms.

SANFORD RILEY STOKER CO., LTD.
Worcester, Mass.

51-4

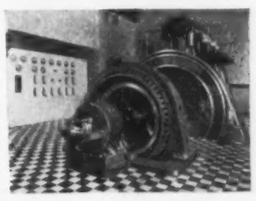
ELECTRIC CRANES
HAND CRANES
ELECTRIC HOISTS
1-BEAM TROLLEYS

SEND FOR BULLETINS.

MARIS BROS., Philadelphia

Green Chain Grate Stokers
For Water Tube and Tubular Boilers
GREEN ENGINEERING CO.
1330 Steger Bldg. CHICAGO, ILL.
Catalog "G"—Green Chain Grate Stoker.
Catalogue No. 8—GECO Pneumatic Ash Handling Systems sent on application.

McINTOSH & SEYMOUR
DIESEL OIL ENGINES
AND
STEAM ENGINES
McINTOSH & SEYMOUR CORPORATION, AUBURN, N. Y.
SOLE AMERICAN LICENSEES SWEDISH DIESEL ENGINE CO.



BRANCH OFFICES:

New York City, 50 Church Street. Boston, 94 Pearl Street. Philadelphia, 131 So. 24th St. St. Paul, 707 Commercial Bldg. Cincinnati, 901 4th National Bank Bldg. Kansas City, 318 New York Life Bldg. Pittsburgh, 1601 Arrott Bldg. Washington, 707 Evans Bldg. Charlotte, N. C., 800 Realty Bldg.

Lyons-Atlas Diesel Engines

VERTICAL, FOUR-CYCLE

300 to 1,000 H. P. Units

The Diesel cycle without modifications—enclosed in a simple massive structure—designed for continuous service—as durable and dependable as the best steam plant. Sold on the merits demonstrated in actual service. Highest efficiency, close regulation and successful parallel operation positively guaranteed. Write us for Bulletin No. 201-A.

Lyons Atlas Company

INDIANAPOLIS, INDIANA, U.S.A.

We Finance
Extensions and Improvements

to Electric Light, Power and Street Railway properties which have established earnings. If prevented from improving or extending your plant because no more bonds can be issued or sold, or for any other reason, correspond with us.

Electric Bond and Share Company

Paid-up Capital and Surplus, $12,500,000

71 Broadway, New York

Dealers in Proven Electric Light, Power and Street Railway Bonds and Stocks.

Worthington Condensing Apparatus

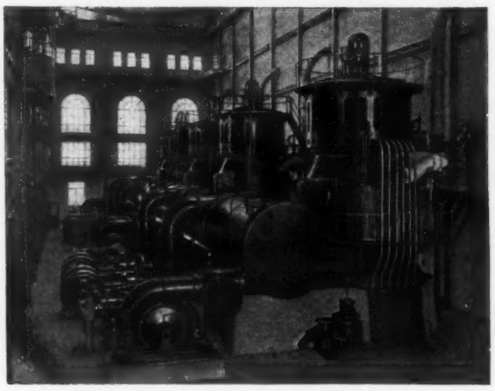
The World Over

All WORTHINGTON CONDENSING APPARATUS, whether of the SURFACE or JET type, is designed upon the counter-current principle, and is capable of maintaining in service the highest vacuum attainable with the quantity and temperature of water for which it is designed.

The success of this apparatus has been due to its careful development along scientific engineering lines, in many of which the WORTHINGTON COMPANY was the Pioneer. All of the details of design are carefully worked out with reference to durability as well as efficiency and absolute reliability in service.

The WORTHINGTON COMPANY will be pleased to furnish preliminary estimates, drawings and advice at all times.

Write For Bulletin W 177-38



HENRY R. WORTHINGTON

115 Broadway, New York **Works: Harrison, N. J.**

Branch Offices in All Large Cities

W240.2

TO PUBLIC UTILITY OPERATORS

Desiring to Reduce Expenses—
Increase Efficiency of Service—
And Increase Earnings

we offer the services of our Engineering Department which is equipped to handle all steam, hydraulic water works, electric and gas engineering problems, together with our Legal Department, which is qualified to prepare and present such cases as you may desire to bring before your State Public Service Commission.

The Light and Development Co.
of St. Louis
Operators of Electric, Gas, Water & Street Ry. Properties
Suite 750, Railway Exchange Building ST. LOUIS, MO.

DIXON'S FLAKE GRAPHITE

Cuts Down Losses in Bearing Friction

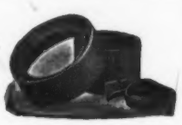
"Lubricating Graphite," Booklet 47

JOSEPH DIXON CRUCIBLE COMPANY

Jersey City, New Jersey 3

FORMICA

COMMUTATOR INSULATING RINGS



The Formica Insulation Co., Inc. Cincinnati, O.

Bruce-Macbeth Gas Engines

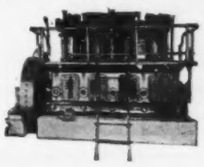
Will reduce your power bills

Many of the largest industrial enterprises in this country have paid for a Gas Plant in from one to two years' time out of the saving over previous power cost.

Will give absolute satisfaction

Over 33% of our orders this year were for repeat installations by concerns already using from one to five of our engines. This is the best possible proof that Bruce-Macbeth Gas Engines are both reliable and efficient.

Ask for copy of Shop Test on any size engine in which you are interested.



MERIAM STEAM PROCESS

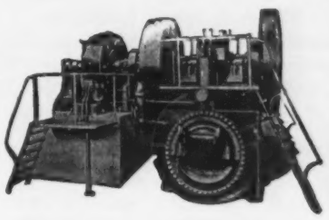
By this new invention you save all cooling water costs, reduce your gas bills, and convert all the heat usually lost to cooling water into steam for heating or other uses.

The Bruce-Macbeth Engine Co
2181 Center St. N.W.
CLEVELAND

Buckeyemobile
THE AMERICAN LOCOMOBILE

the Power Plant of Supreme Efficiency

Built in nine sizes, from 75 H.P. to 600 H.P. through its effective conservation of heat and its utilization of super-heated steam makes possible a lower power cost than has been ever before obtainable by any type of moderate sized steam plant.



Guaranteed to Deliver Current at the Switchboard for about 2½ lbs. of Coal per K.W. Hour

Just think of the tremendous savings you can effect by installing Buckeyemobile Units in your Central Stations and substations. Less labor cost—small coal bills—no transformer losses—converter losses—transmission losses. Over 2,000,000 H.P. of Locomobile Units—the prototype of the modern Buckeyemobile—used in Europe. Cuts *your* costs—boosts *your* dividends. Write for data.

BUCKEYE ENGINE CO., Salem, Ohio

71815

The

COAL & IRON NATIONAL BANK

143 Liberty Street
New York

CAPITAL	SURPLUS & PROFITS (EARNED)
$1,000,000.00	$613,106.79

Keep All Your Boiler Equipment Earning Money All The Time

Keep your steam producing outfit working at full blast all the time—during ebb as well as peak—by installing a

Carbondale Ice Machine

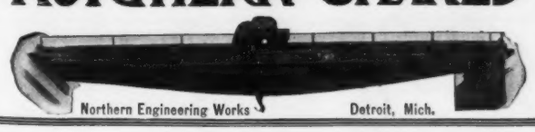
and outfit. Every Central Station should capitalize its natural advantages as a producer of by-product ice. Learn how others are doing it. Write.

CARBONDALE MACHINE COMPANY
CARBONDALE, PA.

Branch Offices: 50 Church Street New York — 1013 Manhattan Bl'd'g Chicago

71063

NORTHERN CRANES



Northern Engineering Works — Detroit, Mich.

PORTLAND WOOD PIPE

Used in many of the world's largest water-works projects. Made of Oregon or Douglas Fir; in continuous Stave Pipe up to 12 feet inside diam. Also Machine Banded, 2-in. to 24-in. Cannot rust or become incrusted. Stands high pressure and any temperature.

Write for complete information and quotations.

PORTLAND WOOD PIPE CO.
P. O. Box 1183 — **Portland, Oregon**
2

15 Years Building DIESEL Engines
Send for Bulletins

DIESEL ENGINES

BUSCH-SULZER BROS.-DIESEL ENGINE COMPANY

Our Engines Operating in 26 States
Watch for our full page ads

St. Louis — Minneapolis, 754 Plymouth Bldg. Houston, 370 Carter Bldg. — San Francisco, 423 Rialto Bldg. Los Angeles, 600 San Fernando Bldg. — U. S. A.

Directory of Engineers

ABBOTT & EATON
Engineers and Managers
Electric Lighting—Gas—Electric Railways
Schofield Bldg., Cleveland, O.

HUGH L. COOPER & CO.
General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.
101 Park Ave. New York

FRANK F. FOWLE
Consulting Electrical Engineer
Chicago, Ill.

AMERICAN DISTRICT STEAM CO.
Engineers and Contractors
Central Station Heating
Power, Lighting, Railways, Gas, Water Works
Plans, Specifications, Examinations and Reports
Chicago, North Tonawanda, N. Y., Seattle

JAMES R. CRAVATH
Consulting Engineer
Illumination, Management and Operation of Electric Light and Power Companies.
Telephone, Randolph, 7184.
140 South Dearborn Street Chicago

GRAVES ENGINEERING CO., Inc.
Manage and Construct
PUBLIC UTILITY PROPERTIES
Examinations and Reports Rate Specialists
35 Pine Street, New York

E. J. ANDREWS
Engineering Patent Attorney
Patents obtained; Validity and Scope of Patents investigated; Infringements, Interferences, and Appeals prosecuted.
1515 Monadnock Block, Chicago, Ill.

DAY & ZIMMERMANN
Successors to
DODGE, DAY & ZIMMERMANN
Engineers, Constructors
Industrial Plants—Public Utilities
611 Chestnut Street, Philadelphia, Pa.

H. E. GREIMS CORPORATION
Examiners of Public Utilities
Audits—Systems—Appraisals—Examinations
TWENTY-FIRST FLOOR, WOOLWORTH BUILDING, NEW YORK

THE ARNOLD CO.
Engineers, Constructors
Electrical—Civil—Mechanical
105 So. La Salle Street, Chicago

KERN DODGE
Consulting Engineer
Morris Building, Philadelphia, Pa.

D. C. & WM. B. JACKSON
Engineers
CHICAGO Harris Trust Bldg. BOSTON 248 Boylston St.
Plans, Specifications, Supervision of Construction
General Superintendence and Management
Examinations and Reports
Financial Investigations and Rate Adjustments

WILLIAM A. BAEHR
Consulting Engineer
Gas and Electric Plants
Design, Construction and Operation
Valuations and Reports
People's Gas Building, Chicago

THIS directory is representative of the leading specialists in each branch of electrical engineering. Use it when in need of professional services.

W. A. JACKSON CO.
Incorporated.
Electrical Engineers & Contractors
Old Colony Building, Chicago
Central Station, Sub-Station and Transmission Line Work

W. S. BARSTOW & CO.
INCORPORATED
Consulting and Construction Engineers
Public Service Properties
Financed and Managed
50 Pine Street, New York

ELECTRICAL TESTING LABORATORIES, Inc.
Electrical and Mechanical Laboratories
Tests of Electrical Machinery, Apparatus and Supplies. Materials of Construction, Coal, Paper, etc. Inspection of Material and Apparatus at Manufactories.
80th St. and East End Ave., New York

J. G. G. Kerry W. G. Chace N. R. Gibson
KERRY & CHACE, Limited
Engineers
Associates—A. L. MUDGE, A. L. MIÉVILLE
Steam and Hydro-Electric Developments, Steam and Electric Railways, Irrigation and Water Supply.
Toronto and Winnipeg

HOMER BROOKE
1790 Broadway, New York
GLASS—ELECTRICALLY—USED
Glass engineer, new and difficult ideas worked out. Large experience, practical
Brooke's Automatic Glass Patents

FARGO ENGINEERING CO.
Jackson, Michigan
HYDRAULIC ENGINEERS
Specialize in the Design of Power Plants and DAMS ON SOIL FOUNDATIONS

HIRAM PERCY MAXIM
Consulting Engineer on
NOISE REDUCTION
Engineer for
THE MAXIM SILENCER COMPANY,
Hartford, Conn.

H. M. BYLLESBY & CO.
INCORPORATED
Chicago, Insurance Exchange Bldg.
New York, Trinity Bldg.
Purchase, Finance, Construct and Operate Electric Light, Gas, Street Railway and Water Power Properties. Examinations and Reports, Utility Securities Bought and Sold.

FORD, BACON & DAVIS
Engineers
115 Broadway
New York
New Orleans San Francisco

McMEEN and MILLER
(Incorporated)
Samuel G. McMeen. Kempster B. Miller.
Leigh S. Keith.
Electrical and Mechanical Engineers
1454 Monadnock Block, Chicago
407 Electric Building, Cleveland

WALTER G. CLARK
Consulting Engineer
Efficiency Investigations; Technical, Financial, Commercial; Analysis Operating Conditions; Consolidations; Power Contracts; Specification, Test and Inspection of Material.
Dallas, Texas. Los Angeles, Cal.
Singer Building, New York.

FORSTALL and ROBISON
Alfred E. Forstall Charles D. Robison
Engineers
Design Operation Appraisal
Gas and Electric Properties
84 William Street, New York City

RALPH McNEILL
Lamp Engineer
Consultation on Machinery for Tungsten and Carbon Incandescent Electric Lamps, Tungsten Wire Drawing, Vacuum Bottles, High Vacuum in General.
New York, N. Y.
Cable address, Vacuneill

Directory of Engineers

RALPH D. MERSHON
Consulting Electrical and Mechanical Engineer
Estimates, Reports, Plans, Specifications and Supervision of Electric Lighting, Railway and Power Plants, Long Distance Power Transmission.
80 Maiden Lane New York

W. EDGAR REED
Consulting Engineer
Designer of Electrical Machinery.
Estimates, Reports, Plans, Specifications and Supervision of Lighting, Railway, Industrial and power Installations.
Frick Annex Building, Pittsburgh, Pa.

JOHN BELLAMY TAYLOR
Consulting Engineer
SCHENECTADY, N. Y. — Office and Laboratory, 23 Lowell Road. Tel. 2791
NEW YORK CITY — 100 Broadway, Tel. Rector 4320
Technical Investigations, Tests, Inspections.
Telephone and Telegraph Relations to Electric Light and Power Systems.
Induction and Earth Current Problems.
Electrical Transmission, Transformation and Distribution.

MOODY ENGINEERING CO.
Engineer
Estimates, Reports, Specifications, Supervision Electric Light and Power Plants, Long Distance Power Transmission, Testing and Inspecting.
115 Broadway, New York City

SANDERSON & PORTER
Engineers and Contractors
Reports, Designs, Construction, Management
Hydro-Electric Developments.
Railway, Light and Power Properties.
New York San Francisco

PERCY H. THOMAS
Consulting Electrical Engineer
Power Transmission, Design, Advice, Supervision, Lightning Protection, Special Investigations
No. 2 Rector St., New York

N. J. NEALL
of Boston
Consulting
Electrical Engineer
Appraisals

SARGENT & LUNDY
FREDERICK SARGENT — A. D. LUNDY
WM. S. MONROE — JAMES LYMAN
Engineers
72 West Adams St.
Chicago, Ill.

UNDERWRITERS' LABORATORIES, Inc.
Under the direction of the
National Board of Fire Underwriters
W. H. MERRILL, Manager
Principal Office and Testing Station, Chicago
Branch Offices in all Principal Cities in the United States and Canada. New York Office, 133 William St. London Office, 48, Westminster Palace Gardens.

NEILER, RICH & CO., Inc.
Successors to Pierce, Richardson & Neiler
Consulting and Designing Engineers
Manhattan Building, Chicago

YOUR card in this space will reach the men you are trying to do business with—a larger number of them than through any other publication.

THE J. G. WHITE COMPANIES
Engineers—Managers
Financiers
43 Exchange Place, New York
Chicago San Francisco

NORTON and BIRD
WILLIAM J. NORTON — PAUL P. BIRD
Engineers
Rate Surveys. Preparation of Rate Schedules, Appraisals, Examinations, Reports, Special Investigations of Public Utility Properties.
111 W. Monroe St. Chicago, Ill.

SCOFIELD ENGINEERING CO.
Consulting Engineers
Power Stations — Gas Works
Hydraulic Developments — Electric Railway
Philadelphia

GARDNER S. WILLIAMS
M. Am. Soc. C. E.
Water Power and Electrical Developments, Reports, Plans, Specifications, Surveys, Superintendence, Estimates and Valuations.
Cornwell Building, Ann Arbor, Mich.

CHARLES L. PILLSBURY
Electrical and Mechanical
Consulting Engineer
Consulting Engineer to Minnesota State Board of Control
Suite 206. Metropolitan Life Building
Minneapolis, Minn.

STONE & WEBSTER ENGINEERING CORPORATION
Constructing Engineers
Boston, Mass.

WOODMANSEE & DAVIDSON, Inc.
Engineers
First National Bank Bldg., Chicago, Ill.

Get your Wants into the Searchlight

VALVES and FITTINGS
All Sizes for all Purposes
Complete Piping Systems
Pittsburgh Valve Foundry & Construction Co.
Pittsburgh, Pa.

For
GENERATING SETS
ENGBERG'S
ELECTRIC & MECHANICAL WORKS
10 Vine St. St. Joseph, Mich., U. S. A.

Card Index — ELECTRICAL WORLD, DECEMBER 19, 1914 — Vol. 64

Public Lighting at Private Expense	1181
The Electric Vehicle in Europe	1182
Efficiency of the Gas-Filled Lamp	1182
Wireless in Time of War	1183
Central-Station Development in Germany	1183
Electrical Energy Exported from Canada	1184
N. E. L. A. Committee on House Wiring	1185
C. M. & St. P. Railway High-Voltage Direct-Current System	1186
Work of the Bureau of Standards	1187
Work of the Bureau of Standards on Safety Rules for Electrical Practice	1188
Hearings on Water-Power Bill	1189
Lighting of the Home	1190
High-Voltage Insulation	1190
Electric Auxiliaries on Automobiles. By George T. Hanchett	1196
Characteristics of the Three-Wire Generator. By O. J. Ferguson	1199
Costs of Electrical Equipment	1204
Results of House Wiring Campaign at Kokomo	1206
Insuring Correct Readings in Electrolysis Survey	1207
Charge for Surplus Power. By H. G. D. Nutting	1208
Scheme to Aid Quick Firing of Boilers	1209
Method of Keeping Turbine Blades Clean	1209
Determining Approximate Ratio of Transformers	1210
Transmitting Signals over Telephone Circuits	1210

GREGORY ELECTRIC CO.
PIONEER ELECTRICAL BARGAIN HOUSE
OFFICE AND WORKS - 16th AND LINCOLN STS. CHICAGO ILL.

Second Hand Electrical Machinery

We handle only late type machines, not taken out of service because worn out or defective, but in first class usable condition. Every machine sold is completely overhauled and fully tested at our works before shipment and is sent out practically new. Send for our "MONTHLY BARGAIN SHEET" showing complete stock with net prices.

FOR SALE

60-Cycle Alternators

K.V.A.			Speed
1	42	Elec. Mach. Co., 220 or 440 v., revolv. field, 3 phase	1200
1	45	Westinghouse, type S, 220 or 440 v., revolv. arm't, 3-phase, 60-cycle	900
1	50	Gen. Elec., ATB, 440 v., revolv. field, 3 phase	1200
1	65	Allis-Chalmers, 3 phase, 440 v., revolv. field, direct con. to Ames engine (new)	275
1	75	Gen. Elec., ATB, 2300 v., revolv. field, 3 phase	900
1	100	Westinghouse, 2300 v., revolv. field, 3 phase	900
1	115	Allis Chalmers, revolv. field, 220 or 440 v., 3 phase	900
2	120	Gen. Elec., type AS	900
1	120	Westinghouse, 3 phase, 1100 or 2200 volt	720
1	125	Fairbanks Morse, 220 v., 3 phase, revolv. field	900
1	200	Gen. Elec., ATB., 2300 v., 3 phase, revolv. field	600
1	200	Westinghouse, 2300 v., 3 phase revolv. field	600
1	200	Western Elec., 440 v., 3 phase, revolv. field	450
1	300	Gen. Elec., ATB., 3 phase, revolv. field, 220 or 440 volts	600

25-Cycle Alternators

K.V.A.			Speed
1	175	Gen. Elec., ATB., 480 v., 3 phase, revolv. field	500
1	300	Gen. Elec., ATB., 3 ph., revolv. field, 220 or 440 volts	500
1	300	Gen. Elec., ATB., 3 ph., revolv. field, 2300 volts	500

Arc Generators

K.V.A.			Speed
1		No. 8½B, Brush, form H, 6.8 amp., 5000 volts, 3 circuit with oil regulators	700
1		No. 9½B, Brush, type PB, 6.6 amp., 6000 v., with 3 circuit oil regulator	700
1	3½	Gen. Elec., type CQ	1300

125-Volt D. C. Generators

K.W.			Speed
2	25	Gen. Elec., Curtis turbine	3600
2	25	Gen. Elec., direct connected to Westinghouse gas or gasoline engines	350
1	27	Ft. Wayne	700
1	28½	Vestinghouse	650
2	30	Northern	1000
1	30	Crocker-Wheeler, direct con. to Erie Ball engine	300
1	30	Gen. Elec., direct-connected to Gen. Elec. engine	305
1	40	West. Elec	775
2	45	Gen. Elec	975
1	45	Westinghouse	850
1	47¼	Westinghouse, S	600
2	50	Triumph	850
1	55	Sprague	625
1	55	Westinghouse, S	800
1	56¼	Westinghouse, M	800
2	60	Northern	825
1	62½	Westinghouse, direct-connected to Atlas 4-valve engine	275
1	70	Ft. Wayne	900
1	75	National, 6-pole	750
1	80	Triumph	275
1	100	Allis-Chalmers	650
1	100	Westinghouse, direct-con. to Ideal engine	250
1	100	Gen. Elec. Curtis turbines	2400

220 to 250 Volt D. C. Generators

KW.			Speed
2	15	Westinghouse	1050
1	15	Ft. Wayne	975
1	17½	Commercial, direct-con. to "Merriam"-Bruce-Macbeth 2 cyl. gasolene engine	300
1	18	Northern	950
2	18	Crocker-Wheeler	900
1	20	Ft. Wayne	1200
1	20	Commercial	1100
1	22½	Westinghouse	975
1	37½	Westinghouse	400
2	40	Gen. Elec	575
3	42	Milwaukee	1100
1	45	Northern	1000
1	45	Western Elec	550
1	50	Northern	650
1	50	Westinghouse, 6-pole, direct-conn. Westinghouse vertical engine.	320
1	65	Milwaukee	950
1	70	Gen. Elec., 3-wire to Shepherd engine	300
1	75	Allis Chalmers	460
1	100	Westinghouse	700
1	100	Goodman	600
1	100	Gen. Elec., 6-pole, form L	600
2	100	Westinghouse, 6-pole, type M	550
1	100	Jenney direct con. to Allfree engine	250
1	100	Westinghouse, direct con. to Chandler Taylor engine	250
1	100	Milwaukee, direct connected to Buckeye engine	250
1	100	Crocker-Wheeler, direct connected to Ideal hor. center center crank engine	250
1	100	Westinghouse, direct-connected to Chandler Taylor engine	250
1	125	Allis-Chalmers	525
1	150	Western Elec., 6-pole	500
1	150	Willey, 8-pole, direct-con. to 4-valve Atlas engine	225
1	240	Crocker-Wheeler, MP, direct con. to 15 x 28 x 36-in. cross-compound Vilter-Corliss engine	120

Three-Phase, 60-Cycle, A. C. Motors

220 or 440 V.

H.P.			Speed
1	2	Watson, 110 v	1120
6	3	Fairbanks-Morse	1800
1	3	Gen. Elec	1800
8	3	Watson, 110 v	1740
1	3	Ideal	1720
2	3	Wagner	1720
2	3	Westinghouse	1700
1	3	Triumph	1140
1	3	Crocker-Wheeler	1130
1	3	Gen. Elec., back-geared	1200–188
8	5	Fairbanks-Morse	1800
1	5	Bell	1800
5	5	Gen. Elec	1800
2	5	Wagner	1720
2	5	Westinghouse	1700
1	5	Gen. Elec., form L	1200
1	5	Fairbanks-Morse	900
1	5	Western Elec	900
1	5	Watson, slip-ring, variable, with controller	1200–800
1	5	Gen. Elec., slip-ring, variable, with controller	900
3	5	Gen. Elec	600
1	7½	Fairbanks Morse	1800
2	7½	Gen. Elec	1800
1	7½	Watson	1740
1	7½	Wagner	1720
2	7½	Westinghouse	1700
2	7½	Gen. Elec., form L	1200
5	7½	Gen. Elec	1200
1	7½	Gen. Elec., slip-ring, variable speed, with controller	1200
1	7½	Westinghouse	1120
1	7½	Westinghouse, type HF, variable, with controller	1120
1	7½	Gen. Elec., form M, slip-ring	900
2	10	Gen. Elec., type K	1800
1	10	Western Elec	1730
2	10	Westinghouse, CCL	1700
1	10	Western Elec	1200
1	10	Gen. Elec., (wound rotor), 110 or 220 v	1200
5	10	Gen. Elec., form K	1200
2	10	Crocker-Wheeler	1200
6	10	Allis-Chalmers	1140
1	10	Westinghouse, CX	1120
2	10	Westinghouse, CCL	1120
1	10	Gen. Elec., form K	900
1	12½	Triumph	1140
1	15	Gen. Elec	1800
1	15	Gen. Elec., L, wound rotor	1200
3	15	Gen. Elec., K	1200
1	15	Gen. Elec., slip-ring, variable speed, elevator motor, with Schureman controller	1200
1	15	Allis-Chalmers	1130
1	15	Westinghouse, CCL	1120
4	15	Westinghouse, CX	1120
1	15	Westinghouse, HF, slip-ring, variable sp., with controller	870
1	15	Gen. Elec., L (wound rotor)	720
1	15	Westinghouse, CCL, back-geared	690–175
1	20	Gen. Elec., K	1800
1	20	Fairbanks-Morse	1200
3	20	Gen. Elec., K	1200
2	20	Gen. Elec., L (wound rotor)	1200
1	20	Lincoln	1200
8	20	Westinghouse, CCL	1150
12	20	Westinghouse, CX	1120
1	20	Fairbanks-Morse	900
1	20	Gen. Elec., L (wound rotor)	900
13	20	Allis-Chalmers	850
4	25	Gen. Elec., K	1200
1	25	Gen. Elec., L (wound rotor), 550 v	1200
1	25	Wagner	1140
1	25	Gen. Elec. (wound rotor)	900

Three-Phase, 60-Cycle A. C. Motors

H.P.			Speed
4	25	Western Elec	850
1	25	Gen. Elec., K	720
2	30	Fairbanks-Morse	1200
1	30	Fairbanks-Morse, slip-ring	1200
10	30	Westinghouse, CX	1120
5	30	Westinghouse, CCL	1120
1	30	Westinghouse, CCL	840
4	35	Western Elec	900
2	35	Gen. Elec. Co., K	900
1	35	Allis-Chalmers	850
1	40	Fairbanks-Morse	1200
13	40	Westinghouse, CX	850
1	40	Allis-Chalmers	850
1	50	Westinghouse, CCL	1120
2	50	Fairbanks-Morse, slip-ring	900
4	50	Gen. Elec., K	900
6	50	Westinghouse, CCL	850
12	50	Westinghouse, CX	850
7	55	Gen. Elec., K	514
1	60	Western Elec., CS	900
4	75	Westinghouse, CX	850
1	75	Westinghouse, CCL	850
1	75	Gen. Elec., K, 2200 v.	720
1	100	Fairbanks-Morse	720
1	100	Gen. Elec., K	720
1	100	Westinghouse, CX	690
8	125	Westinghouse, type F, No. 107, slip-ring, constant speed, with starters	580
5	125	Westinghouse, type F, No. 107, slip-ring, variable speed, with drum controllers	580
1	150	Westinghouse, type CCL, 2300 volts, direct-con. to American centrifugal pump	1120
1	150	Gen. Elec., form K, 220 v	720

Three-Phase, 60-Cycle Motors 220 or 440 V.

H.P.			Speed
1	2	Gen. Elec	1500
1	6	Gen. Elec	1500
1	7½	Westinghouse	710
1	10	Fairbanks Morse	750
3	10	Gen. Elec., form K	750
1	12	Gen. Elec., form K	1500
1	15	Gen. Elec., form K	750
1	20	Westinghouse, type CCL	710
15	30	Gen. Elec., form K	750
1	30	Gen. Elec., mill type, encl., slip ring, variable, with con troller, back-geared	500–172
2	75	Westinghouse, type CCL, direct-con. to Wood centrifugal pumps	720
1	85	Gen. Elec., form K	750
1	100	Westinghouse, type HF, slip-ring	720
10	100	Westinghouse, type F, slip-ring	480
4	100	Westinghouse, type F, slip-ring, variable speed, with drum controllers and resistances	480
1	175	Gen. Elec., form K	500
1	250	Westinghouse, type CCL	480

SEARCHLIGHTS—FOR SALE OR RENT

2		20 amp. Gen. Elec., 110-125 volt d. c.	

SEARCHLIGHT SECTION

ELECTRICAL AND STEAM MACHINERY FOR SALE

ALTERNATING CURRENT UNITS

Two 500 KW., Westinghouse horizontal turbo generator sets, 60 cycle, 2300 volts, 3 phase (or 2 phase), 3600 R.P.M.

One 500 KW., General Electric Turbo, Generating set, generator being type ATB, 4-500-1800 R.P.M., 3-phase, 60-cycle, 2300-600 volts.

Two 400 KW., G.E. 3 phase, 60 cycle, 2300 volt, 150 R.P.M. each direct coupled 18 & 36 x 30. Buckeye heavy duty engines.

Two 360 KVA., Rev. Field Alternator, 3-phase, 60-cycle, 2300 volts, direct connected to 19 & 32 x 24" Tandem Compound heavy duty McEwen engines, speed 150 R.P.M.

One 300 KW., Rev. Field Alternator, 3-phase, 60-cycle, 440 or 2300 volts, direct connected to 14 and 28 x 30" Cross Compound Allis-Chalmers four-valve engine, 150 R.P.M.

One 200 KW., General Electric ATB, rev. fld., 3-phase, 60-cycle, 2300 or 480 volts, 200 R.P.M., direct connected to 15 and 26 x 17 McIntosh & Seymour engine.

One 150 KW., Allis-Chal., rev. fld., 3-phase, 60-cy., 2300 or 480 volts, 180 R.P.M., direct connected to 18 x 17 Harrisburg four-valve side crank engine.

MOTOR GENERATOR SETS

One 150 KW., General Electric, CLB, 550 volt, direct coupled to 220 H.P., General Electric, 3-phase, 60-cycle, 2080 volt induction motor, speed 514 R.P.M.

One 100 KW., 125 volt, General Electric Interpole type, direct coupled to 133 H.P., 3-phase, 60-cycle, 2300 volt General Electric synchronous motor, 900 R.P.M.

BELTED ALTERNATORS, 60 CYCLE

One 400 KW., Westg., rev. fld., 3-phase, 440 or 2300 V., 400 R.P.M.
One 250 KW., West., rev. fld., 3-phase, 60-cycle, 2300 volts, 450 R.P.M.
One 200 KW., G. E. rev. fld., 3-phase, 60-cycle, 2300 volts, 600 R.P.M.
Two 150 KW., G.E., form P., 3-ph., 60-cy., 480-240 volts, 600 R.P.M.
One 125 KW., Westg., rev. fld., 3-phase, 60-cycle, 2200 volt, 900 R.P.M.

DIRECT CURRENT DYNAMOS 250 VOLTS

One 250 KW., Cro. Wheeler, 250 volt, 165 R.P.M., direct connected 22 x 24 Clarke Brothers four valve horizontal engine.
One 200 KW., G. E., 8-pole, 250-volt, compound wound, 200 R.P.M., direct connected to 18 x 17 Harrisburg, 4-valve, side crank.
One 100 KW., General Electric, CLB., 550 R.P.M., 6-pole, 250 volt.
One 55 KW., General Electric, CLB., 625 R.P.M., belted 250 volt.

ARCHER & BALDWIN, 114-118 Liberty Street, New York
ROOM No. 302 Phone, Rector 4337-8-9

Commonwealth Edison Company.
Repair Shops
Telephone Randolph 1280
38 North Market Street,
Chicago
Dynamos. Motors. Transformers.
Arc Lamps and Appliances
High grade machine work of all kinds
Correspondence Solicited-

GENERAL ELECTRIC AUTOMATIC REGULATORS—BRAND NEW

Two 100 Amp., 2300 V., 10% buck and boost. Two 150 Amp., 2300 V., 10% buck and boost. Each complete with operating motors and all auxiliary apparatus.

Five 25 Amp. Second hand regulators, in excellent condition; all complete with operating motors and auxiliary apparatus.

ROTARY CONVERTER

300 KW., 550 volt, 900 RPM., General Electric Rotary Converter, type HC, Form P, in very fine condition with panel.

MOTOR GENERATOR

200 KW., 550 V., General Electric Inner Pole Generator direct connected to a 240 KVA, 60 cycle, 3 phase, 2300 volt General Electric self-starting synchronous motor with compensator and direct connected Exciter.

We also carry a large stock of motors for all requirements, frequency changers, voltage regulators, large transformers, exciter sets, etc.

GEO. SACHSENMAIER & CO.
143-45 N. 3d St., Philadelphia, Pa.

Du Zets & Son
Hudson Terminal Building, New York

SPECIALS.

2—300 K.W. General Electric, type "ATB," 3 phase, 60 cycle, 600 volt alternator, direct connected Harrisburg engines, with switchboards and exciters.

2—300 K.W. Westinghouse-Parsons turbines, 3 phase, 60 cycle, 2300 volt. with switchboard.

300 K.V.A. Westinghouse, 3 phase, 60 cycle, 440-220 volt alternator direct connected Erie City tangye frame engine, with exciter and switchboard.

160 K.V.A. Crocker-Wheeler, 3 phase, 60 cycle, 240 volt alternator, direct connected Straight Line engine with exciter and switchboard.

60 K.W. Westinghouse, 3 phase, 60 cycle, 220 volt alternator, direct connected Harrisburg engine with exciter and switchboard.

SEND FOR COMPLETE BARGAIN LIST

GAS ENGINE UNITS

21x30 Twin Tandem Cooper Gas Engines with 800 KVA., 3 Phase Generators complete.

One 400 HP., 4 Cylinder, Vertical, Gas Engine, with 250 KVA., 3 Phase Generator complete.

One 360 HP., 3 Cylinder, Westinghouse, Gas Engine, with 3 Phase Generator.

Two 300 HP. 3 Cylinder, Vertical, Westinghouse, with 3 Phase Generator.

60 others, all kinds and voltages.

Also some Producer Units.

Largest stock between New York and Chicago.

Edgar M. Moore & Company
Pittsburgh, Pa.

New and Used Electrical and Steam Machinery

HAROLD R. WILSON MACHINERY COMPANY
New Bank of Commerce Bldg., ST. LOUIS, MO.
DIRECT CONNECTED AC. UNITS (60 CYCLES)

K.W.	Make	Volts	Ph.	Engine Description
1000	Gen. Elec.	2300	2or3	to Curtis Hor. High Press. Turb.
1000	Gen. Elec.	2300	2or3	to Curtis Mixed Press. Hor. Turb.
1000	Westge.	6000/2300	2or3	to Parsons Low Press. Hor. Turb.
3— 500	Westge.	440	2or3	to Parsons High Press. Hor. Turb.
2— 400	Gen. Elec.	2300	2or3	to 18&36x30 Buckeye Hor. C. C.
400	Gen. Elec.	2300	2or3	to 16&32x30 McI. & S. Vert. C. C.
2— 300	Gen. Elec.	600/2300	2or3	to 16&28x24 Harrisburg 4 Valve C. C.

Other Sizes—Also A.C. & D.C. Belted Dynamos—Motors Engines—Boilers—Rotaries—Electric Cars, Etc.

YOU CAN SAVE 50%
IN THE PURCHASE OF A-I APPARATUS
SPECIALS

400 K.W. Westinghouse Parsons, 60 cy., 2 or 3 ph., 440 v., with condenser.

300 H.P. Smith type E Gas Producer Plant, complete.

PAUL STEWART & CO. CINCINNATI, O.

SEARCHLIGHT SECTION

MACGOVERN AND COMPANY, INC.

FRANK MACGOVERN, Pres. & Gen. Mgr.
114 LIBERTY STREET NEW YORK CITY
'Phone, 3375-3376 Rector

ALTERNATING CURRENT, DIRECT CONNECTED UNITS
60 CYCLE

2—400 K.W. General Electric, form A, 2300 volt, 48 pole, 150 RPM., dir. conn. to 18" & 36" x 30" Buckeye, R.H., heavy duty, C.C. engines.
1—330 K.W. Stanley, 2400 volt, inductor type, 164 RPM., dir. conn. to 18" & 24" x 30" Russell tandem right hand, 4-valve engine.
1—300 K.W. Crocker-Wheeler, 600 volt, revolving field, 150 RPM., with Buckeye Engine.
1—240 K.W. General Electric, 480 volt, ATB, form E, 200 RPM., dir. conn. to 17½" x 21" Buckeye heavy duty, piston valve engine.

THIS IS OF NECESSITY ONLY A PARTIAL LIST—
SEND FOR CATALOG

If You Do Not Find What You Want

in the Searchlight Section of the ELECTRICAL WORLD write to us and we will try to get it for you.

FOR SALE

Oil Engines for Sale

One 60 H.P. St. Marys Oil Engine, Special Elec. Type, good as new; one 30 H.F. same as above only higher speed; one 60 H.P. Taylor Steam Engine, good condition, $100 f.o.b. cars. Buying power from traction company reason for selling. Archibold Elec. Lt. & Pr. Co., Archbold, Ohio.

200 KVA., A.C. Diesel Oil Engine Unit

200 KVA Westge., 2300 volts, 3 phase, 60 cycles A.C. generator, direct connected to a 3-cylinder, vertical Diesel oil engine. Unit used 18 months; as good as new; complete with accessories. Box 3587, Elec. World.

Receiver's Sale

Well located and equipped gas and electric lighting fixture factory, situated at Winsted, Conn. Now operating. Unusual opportunity for a practical man to acquire an established business with possibility of rapid extension, at much less than actual value. Address Gilbert L. Hart, Receiver, Goodwin & Kintz Co., Winsted, Conn.

Electrical Sheet Steel for Sale as Follows:

Approximately 128,000 lbs. No. 26 U. S. Gauge by 17" wide by 120" long. 380,000 lbs. No. 26 U. S. Gauge 16" wide x 96" long. 62,000 lbs. No. 26 U. S. Gauge, 24" wide x 96" long. 41,000 lbs. No. 26 U. S. Gauge x 25" wide x 98" long. 45,000 lbs. No. 26 U. S. Gauge 13¼" wide x 93" long. Also 33,000 lbs. No. 16 U. S. Gauge 26" wide x 96" long open-hearth blue annealed sheet steel. 61.000 lbs. ⅛" x 17" wide x 120" long open-hearth blue annealed sheet steel. 130,000 lbs. ⅛" U. S. Gauge 16" x 96" long open-hearth blue annealed sheet steel. The material is in first class condition and if interested make us a proposition. Address reply to Box 3596, Elec. World.

Watt Meters for Sale

25—Late Type M Thomson Recording D. C. Watt Meters, 5 ampere, 110 volt, 2 wire, A1 shape. $5[illegible] a piece. Wisconsin-Minnesota Light & Power Co., La Cross, Wis.

Arc Lamps and Transformer

Forty-five Adams-Bagnall 6.6 ampere arc lamps for sale, all in good condition; complete with outer and inner globes and reflectors. Also one G. E. Tub transformer. Will sell all or part at low price. Address Sterling Consolidated Electric Company, Sterling, Colo.

Get your Wants into the Searchlight

ADVERTISING RATES

Positions Wanted, Evening Work Wanted. 2 cents a word, minimum charge 50 cents an insertion, payable in advance.

Positions Vacant, Salesmen Wanted, Agencies, all undisplayed Miscellaneous ads, Machinery and Plants For Sale (with one line of display heading), 3 cents a word, minimum charge $1.50 an insertion.

All advertisements for bids cost $2.40 an inch.

Advertisements in display type cost as follows for single insertions:

1-16 page, $6.25	1 in. single col., $4.00
1-8 page, 12.50	4 in. single col., 15.20
1-4 page, 25.00	8 in. single col., 29:20

In replying to advertisements, send copies of testimonials, etc., instead of originals.

FOR SALE

Generator and Switchboard

One 25 K. W. Holtzer-Cabot D.C. Generator with switchboard for sale. A1 condition. Lucas & Son, Bridgeport, Conn.

Machinery for Sale

I have for sale at a bargain one Skinner Automatic non-condensing, single cylinder, 60 H. P. fly-wheel, Type Governor, steam Engine, direct connected to one Western Electric, 40 K.W., 250 volt, 290 R.P.M. direct current generator with one Atlas 70 H.P. Water Tube Boiler. One Reeves triple cylinder, 50 H.P. Gas Engine, practically new, direct connected to one 40 K.W. Western Electric 250 volt, 290 R.P.M. direct current generator. One Reeves 20 H.P. single cylinder Gas Engine belted to one 16 K.W. Wood Generator, 250 volt direct current generator with fly-wheel balancer. 100 5 ampere D.C. Duncan watt-hour meters, also panel switchboard complete. The above apparatus is in good operating condition, and can be inspected while operating. Will sell any or all machinery. Would make ideal installation for small town lighting plant, or for individual isolated plant. Cause of sale, going to purchase current from local railway company. Address Thos. R. Woulfe, Kamms, Ohio.

Machinery for Sale

One 100 K.W. Western Electric, 250 volt, D.C., 600 RPM, Generator, $500.00. One 75 K.W., National Electric, 250 volt, D.C., 750 RPM, Generator, $350.00. Two complete panels for above at a low price. One Erie Ball, 14 x 14, 280 RPM, 140 H.P. engine, $325.00. Janesville Electric Co., Janesville, Wis.

MISCELLANEOUS WANTS

Electric Light Property Wanted

An electric light and power property in town of 3000 to 5000 inhabitants. Middle West preferred. Reply with details to Box 3561, Elec. World.

A Good Reliable Institution

A good reliable institution wants to manufacture patented articles on a royalty, or make some satisfactory arrangement with the inventor; something in the line of brass or electrical goods preferred, or we are in a position to finance a small manufacturer who has not sufficient capital to carry on his business by buying it outright or by making some other arrangement that might be satisfactory to the owner. Address "C. T. B.," Box 3576, Elec. World.

Electric Light Plant Wanted

Wanted to purchase, an electric light plant in district of 3000 population or larger. Address R. S. Ashe, Engineer, Richmond, Ind.

Pump Wanted

A 7" x 10" triplex pump wanted, 150 pounds pressure, in good condition. Box 3614, Elec. World.

Exciter Wanted

One—100 K. W. 60-cycle revolving field, general electric type "A. S.," 6600 volts, exciter and auxiliaries complete, belt driven, alternating current, single phase. Give serial number, price, etc. Box 3621, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

PROPOSALS

TREASURY DEPARTMENT, SUPERVISing Architect's Office, Washington, D. C., December 15, 1914.—Sealed proposals will be received at this office until 3 p. m. January 15, 1915, and then opened for the installation complete of an electric freight elevator, etc., in the United States post office and courthouse at Manchester, N. H., in accordance with the drawing and specification, copies of which may be had at this office in the discretion of the Supervising Architect. O. WENDEROTH, Supervising Architect. N. B.—Bidders are required to return the drawing and specification without marks, notes, or other mutilations. The Government frank sent to intending bidders is to be used for the return of drawing and specification, and for no other purpose.

SEARCHLIGHT SECTION

POSITIONS WANTED

COMPETENT stenographer wants position as secretary to executive of public utility company. Capable correspondent, understands and can install efficient office system, good executive ability. Address Box 3603, Elec. World.

ELECTRICAL and mechanical engineer, 12 years' practice with every branch electrical industry. Speaks Spanish, Portuguese, French, German, Italian, English. Good knowledge of South America. Would take position there as salesman. Box 3607, Elec. World.

ELECTRICAL engineering graduate, good school, 3½ years' G. E. test; 2 years with steam plant. Gas engine and steam turbine experience. Will go anywhere in this or foreign country as engineer, or manager, or will handle small plant. Good references. Box 3531, Elec. World.

ELECTRICAL engineer, technical graduate, 5 years' experience in shop, drafting, electrical and steam testing construction, cost. Position desired in engineering, sales or cost department. Box 3537, Elec. World.

ELECTRICAL engineer, University of Michigan graduate, 26, single, three years' experience with large power company in design, construction and operation. At present employed. Box 3571, Elec. World.

ELECTRICAL engineer and superintendent, technical graduate with 15 years' practical experience, engineering, construction and operation, railway, lighting and power systems. Now with large company; desires change. A1 references. Box 3398, Elec. World.

ELECTRICAL engineer, college graduate, 6 years' experience in electrical and telephone engineering, construction and maintenance of telephone plants. Open for employment after Jan. 1st. References. Box 3608, Elec. World.

ELECTRICAL superintendent, age 36, 2½ years superintendent of public utility; 4 years electrical engineer for large industrial company; several years supervising construction and operation. Knowledge of public utility laws and regulations. Open for engagement. Best references. Box 3610, Elec. World.

ELECTRIC heating—Young man with 9 years' manufacturing and selling experience. Thorough knowledge of all lines now on market. Capable of handling new business department or a selling position with manufacturer. Box 3565, Elec. World.

ELECTRICAL engineer, 23 years, graduate, 1914, Polytechnic Institute, Zurich, Switzerland, desires position with reliable company offering opportunity for advancement; salary no object. M. Mazza, 116 Nassau St., New York City.

ELECTRICAL superintendent having successfully built and operated central stations for light and railways for over twenty years, desires connection with utility company or engineering firm in any capacity. Can build or operate with maximum efficiency. Box 3536, Elec. World.

ELECTRICAL superintendent or operating engineer desires position. Twenty years' practical experience in the management and operation of both A. C. and D. C. central stations. Box 3555, Elec. World.

POSITIONS WANTED

HIGH-GRADE manager of railroad and public utility properties, open for engagement. Desire to change on account of climate. Box 2947, Elec. World.

INDUSTRIOUS young man, 21 years of age, wishes position in electric power plant. 1½ years' experience at electrical work. I. C. S. graduate. Not afraid of work. Box 3620, Elec. World.

POSITION wanted as superintendent or superintendent and manager of central station. Thoroughly familiar with operation and management. Technical and business education and experience. Employed. Town of from 3,000 to 6,000 in Wisconsin, Illinois or Iowa preferred. Box 3617, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

SALES engineer, 22 years' experience, open to represent first class mechanical or electrical manufacturing firms in San Francisco or Pacific territory. Or would look after interests of a good firm during San Francisco Exposition. Represented two important British firms in Canada successfully for past six years. War cause for leaving. Can furnish first class references regarding ability, and character. Can also furnish satisfactory bank references, A. M. I. E. E., also Associate Canadian Civil Engineer and a good Jovian. Address Box 3595, Elec. World, Rialto Bldg., San Francisco, Cal.

SUPERINTENDENT or foreman, 29, married, 12 years' experience in construction and operation of switchboards, motors and meters. At present employed. Permanent position desired. Best of references. Box 3574, Elec. World.

YOUNG engineer, general electric test and five years' experience, power and substation, drafting, constructing and maintenance, high tension lines, etc., seeks permanent opportunity. Address Box 3399, Elec. World.

POSITIONS VACANT

ACCOUNTANT with first class experience in keeping accounts of electric light utility wanted. Good opening for a young man with some executive ability, who is familiar with all phases of a first class accounting system, including cost accounting, office system, consumers' accounts, merchandise sales accounts and financial reports. Give full particulars. Box 3611, Elec. World.

AGGRESSIVE, experienced repair man who has had years of experience in large repair shop doing all classes of repair work. Prefer to see applicant in person, but inexpensive photo might do. State full particulars, age, weight, salary beginning. Wiring experience advantageous. Producers only wanted. Scott Bros. Electric Co., Detroit, Mich.

INCANDESCENT lamp salesmen for New York City and vicinity for an independent, wire-drawn, Tungsten lamp. Give experience, age and full particulars regarding where previously employed. Box 3615, Elec. World.

STORAGE battery engineer required for England. Must be up to date in works experience. Address Box 3609, Elec. World.

WANTED—A first class engineer to take full charge of large steam turbine station; must be a hustler who can show a record. Applicant must be under 45 years old and have first class Mass. license. Box 3606, Elec. World.

AGENTS AND SALESMEN

Wanted by an Experienced Salesman

A good line of Tungsten and carbon lamps to sell on commission or salary in Vermont, New Hampshire and Maine. Highest references furnished. Box 3588, Elec. World.

Agents Wanted

To handle our electrically driven portable grinders and polishing machines for shops, garages, plating establishments, jewelers, opticians and for polishing silverware in hotels or in the home. Excellent opportunity. Write for particulars. The Atwater Electric Works, Coopersville, N. Y.

Agency Wanted

Electrical engineer with ten years' of excellent experience covering all branches of electric light and power work, desires to represent electrical manufacturer. Will open office as sole agent for Greater New York or take several lines on a commission or other equitable basis. Box 3602, Elec. World.

Do You Want Representation In St. Louis

A responsible, technically trained young man will entertain proposition from responsible manufacturers with a view of opening a St. Louis sales office on a commission basis. References given. Box 3618, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

Chicago Representative

desires new lines (electrical or mechanical) for personal high grade selling. Now calling on electrical jobbers, contractors, etc. Can carry small accounts and have large storage room with office force. Central location. Inquiry solicited. Box 3616, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

EMPLOYMENT AGENCIES

AMERICAN SERVICE COMPANY, General Engineering Agency, Pittsburgh, Penna. Solicits confidential employment records of available Electrical Power and Industrial Engineers, Master Mechanics, Designers, Electricians, Business, Sales and Accounting executives for general proposals to employing authorities. Vacancy Notices and Opportunities solicited everywhere and records submitted to employers for approval and without obligations.

EDUCATIONAL

METERMEN WANTED to enroll for complete practical course on "Electrical Measuring Instruments and Meters." Endorsed by leading electrical men. Write for booklet, "Instruments and Meters," giving full information. Fort Wayne Correspondence School, 913 Shoaff Bldg., Fort Wayne, Ind.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.—Courses in Civil, Mechanical, Electrical and Chemical Engineering and General Science, leading to the degree of Civil Engineer (C.E.), Mechanical Engineer (M.E.), Electrical Engineer (E.E.), Chemical Engineer (Ch.E.), and Bachelor of Science (B.S.) Also special courses. Splendidly equipped new engineering laboratories. Send for catalog to the Registrar.

The Author and The Book

THE AUTHOR

It would be hard to find a man better equipped than Terrell Croft to prepare a practical electrical book. He served first as a wireman, trouble-shooter, lineman and dynamo tender. Subsequently he studied Electrical Engineering at Pratt Institute and became a practicing Electrical Engineer.

For years he has contributed articles on practical electrical matters to the technical press. He has developed a remarkable knack of clear, simple statement of the most complex subjects. He has been an indefatigable collector of data.

He knows the needs of the practical electrician and the electrical engineer, and his book meets the requirements of both.

THE BOOK

A practical book—a tool—for all practical men. Never before has there been such a book—one that covered all the practical problems of electricity in a way that is so easy to understand.

In a compact leather pocketbook of 700 pages there are all the facts about practical electricity. Every single fact is brought out clearly and concisely. You do not have to work out the answer—it is given for you, and there are over 900 illustrations in the book which show exactly the right way to handle the problem.

This book really contains the material of six ordinary books. It covers:

Fundamentals	**Interior Wiring**
Generators and Motors	**Transformers**
Outside Distribution	**Illumination**

Send for a Copy for Free Examination—No Money Down

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.,
239 West 39th Street, New York, N. Y.

You may send me on 10 days' approval:
Croft—American Electricians' Handbook, $3.00 net.
I agree to pay for the book or return it postpaid within 10 days of receipt.

— — I am a regular subscriber to the Electrical World.
— — I am a member of A. I. E. E.

(Signed) .....

(Address) .....

.....

Reference W12-26

(Not required of subscribers to the Electrical World or members of A. I. E. E.)

Sent on Approval—No Advance Remittance

We will send this book or any book published by the McGRAW-HILL BOOK COMPANY, Inc., to any subscriber to the ELECTRICAL WORLD or any member of the American Institute of Electrical Engineers for 10 days' free examination.

If you are not a subscriber to ELECTRICAL WORLD or a member of the American Institute of Electrical Engineers, a reference will give you the same privilege.

No books sent on approval outside of the United States or to booksellers and agents.

McGraw-Hill Book Co.

Incorporated

239 West 39th Street **New York**

Berlin **London**

Publishers of Books for Electrical World

Can't we get a good motor built especially for us?

"A poor motor is ruining our product", said the Sales Manager. "We've never seemed able to get a motor that is exactly suited to our machine. What we want, what we must have, is a motor that is "fool proof", always reliable, sturdy, compact, light weight,---in short, a motor as good as our product and in every way fitted to it."

That Sales Manager grasped the weakness of many of the present motor driven devices. Of what use are the many attachments and exclusive features you've worked so hard to incorporate into your machine if the motor goes wrong? Remember, people don't blame the motor when it balks---they condemn the whole machine.

We are small motor specialists and our engineers challenge you to put an application up to them that they can't solve. Not only that, but we have the best equipment and organization in the country with which to build both standard and special motors in any quantities.

If you have a machine or especially if you market a product and wish to equip it with the best fractional horse power motor, it will pay you to send for our Bulletin 1146 and learn what we are doing for the majority of the leading manufacturers of industrial and domestic power driven devices.

FORT WAYNE ELECTRIC WORKS

OF GENERAL ELECTRIC COMPANY

"WOOD" SYSTEMS

Main Office
FORT WAYNE, INDIANA

Branch Offices
ALL LARGE CITIES

M-46

Inside Facts on Modern Boiler Firing Practice

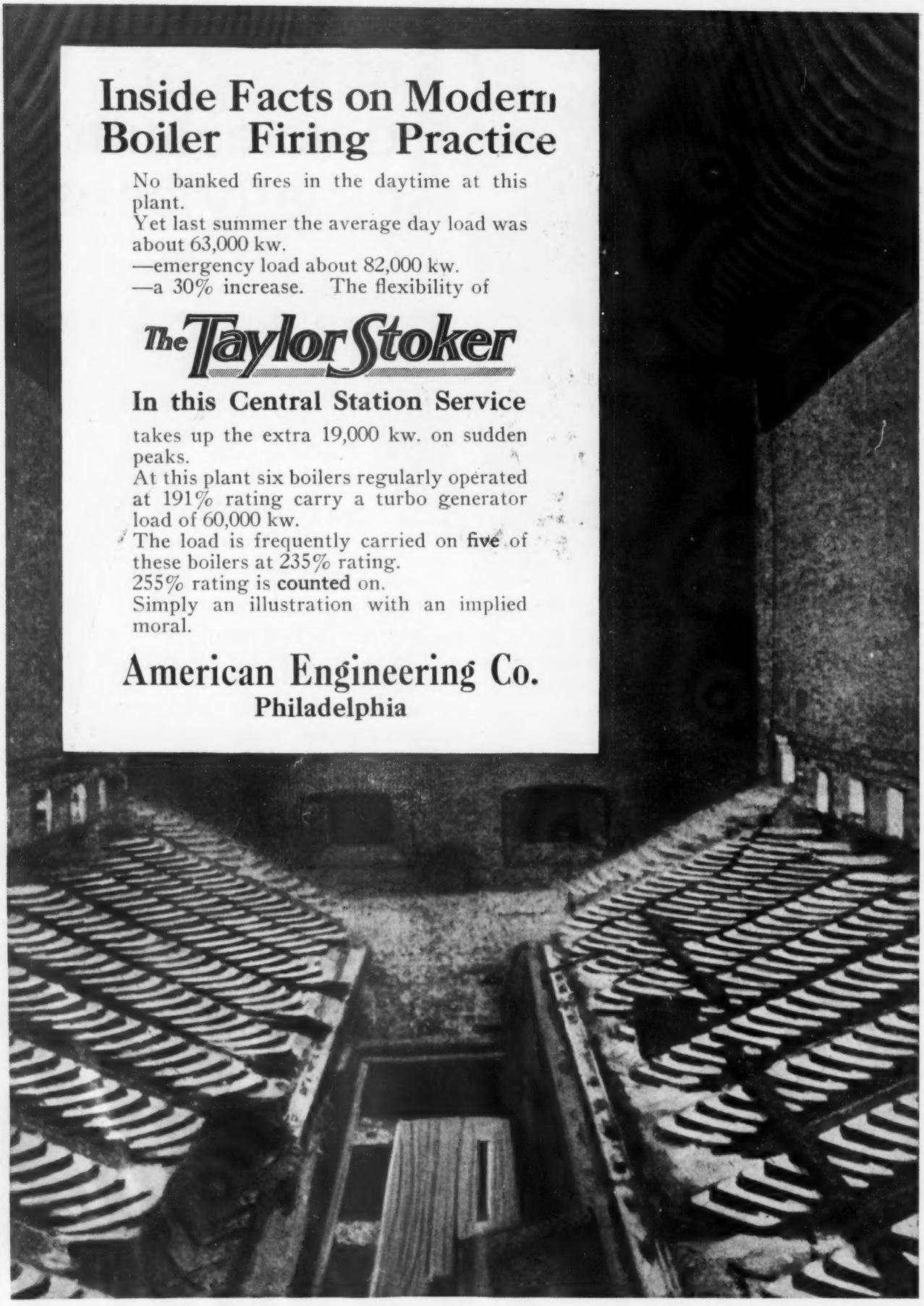
No banked fires in the daytime at this plant.
Yet last summer the average day load was about 63,000 kw.
—emergency load about 82,000 kw.
—a 30% increase. The flexibility of

The Taylor Stoker

In this Central Station Service

takes up the extra 19,000 kw. on sudden peaks.
At this plant six boilers regularly operated at 191% rating carry a turbo generator load of 60,000 kw.
The load is frequently carried on **five** of these boilers at 235% rating.
255% rating is **counted** on.
Simply an illustration with an implied moral.

American Engineering Co.
Philadelphia



READY-REFERENCE INDEX

to products manufactured by advertisers in this issue of Electrical World

Nearly 300 different products are here listed.

The Alphabetical Index (see fourth page following) gives the page number of each advertisement.

As far as possible advertisements are so arranged that those relating to the same kind of goods or apparatus will be found together.

This ready-reference index is up to date, changes being made each week.

If you don't find listed in these pages any electrical product of which you desire the name of the maker, write or wire Electrical World, and we will promptly furnish the information.

Accountants.
Greims Corp., H. E.

Air Compressors.
Allis-Chalmers Mfg. Co.
Murray Iron Works.

Aluminum.
Aluminum Co. of America.

Ammeters, Voltmeters.
(See Instruments, Electrical.)

Anchors, Guy.
Matthews & Bro., Inc., W. N.

Annunciators.
Ostrander & Co., W. R.

Asbestos, Wood.
Johns-Manville Co., H. W.

Ball Bearings.
Hess-Bright Mfg. Co.
Norma Co. of America.

Batteries, Dry Cell.
Johns-Manville Co., H. W.
Manhattan Elec'l Supply Co.
Nungesser Carbon & Battery Co.

Batteries, Primary.
Western Elec. Co.

Batteries, Storage.
Edison Storage Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Petschel Storage Battery Co.
Storage Battery Supply Co.

Battery Connections.
Fahnestock Electric Co.

Bells.
Manhattan Elec'l Supply Co.
Ostrander & Co., W. R.

Belting.
Chicago Rawhide Co.

Binding Posts.
Fahnestock Electric Co.

Boilers.
Babcock & Wilcox Co.
Murray Iron Works.

Bolts, Expansion.
Hubbard & Co.

Books, Technical.
McGraw-Hill Book Co., Inc.

Boosters.
C. & C. Elec. & Mfg. Co.
Crocker-Wheeler Co.
General Elec. Co.
Westinghouse Elec. & Mfg. Co.

Boxes, Fuse.
General Elec. Co.
Johns-Manville Co., H. W.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g Co.

Boxes, Junction and Outlet.
Chicago Fuse Mfg. Co.
D. & W. Fuse Co.
Johns-Manville Co., H. W.

Boxes, Meter and Service.
Johns-Manville Co., H. W.
Metropolitan Eng'g Co.

Brackets and Pins, Metal.
Hubbard & Co.
Pittsburg Transformer Co.

Brushes, Dynamo.
Holmes Fibre Graphite Co.
Jeandron, W. J.
Morgan Crucible Co., Ltd.
Stackpole Carbon Co.

Building, Steel.
Blaw Steel Cons. Co.

Bushings.
Condit Electrical Mfg. Co.
Diamond State Fibre Co.
New Process Specialty Co.

Cable End Bells.
Elec'l Engineers Equip. Co.

Cable Joints.
G. & W. Electric Specialty Co.

Cable Racks.
Cope, T. J.
Metropolitan Eng'g Co.

Cable Splicing Joints.
Matthews & Bro., Inc., W. N.

Cabling Machinery.
American Ins. Machinery Co.
New England Butt Co.
Torrington Mfg. Co.

Carbon.
Stackpole Carbon Co.

Car Heaters, Electric.
Simplex Electric Heating Co.

Castings.
Pittsburgh Valve, F. & C. Co.

Chains, Driving.
Morse Chain Co.

Chandeliers.
Benjamin Elec. Mfg. Co.

Circuit Breakers.
Baruch Elec. & Controller Corp.
Condit Electrical Mfg. Co.
General Electric Co.
Machado & Roller.
Roller-Smith Co.
Sangamo Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Clamps, Ground Connection.
Belden Mfg. Co.

Clamps, Guy.
Matthews & Bro., Inc., W. N.

Cleats.
Blake Signal & Mfg. Co.
Colonial Sign & Ins. Co.
Imperial Porcelain Co.
National Metal Molding Co.
Star Porcelain Co.
Thomas & Sons, R.

Climbers.
Klein & Sons, Mathias.

Clips, Cable.
Matthews & Bro., Inc., W. N.

Clips, Testing.
Mueller & Co., R. S.

Clusters.
Benjamin Electric Mfg. Co.
Hubbell, Inc., Harvey.

Coils, Armature Field.
D. & W. Fuse Co.
Independent Lamp & Wire Co.

Coils, Choke.
General Elec. Co.

Coils, Induction.
Ostrander & Co., W. R.

Commutator Truers.
Jordan Bros.

Compounds, Boiler.
Dearborn Chemical Co.

Compounds, Commutator.
McLellan Co., K.

Condensers.
Westinghouse Machine Co.
Worthington, H. R.

Conduit Bends.
Fibre Conduit Co.

Conduit Rods.
Cope, T. J.

Conduits, Interior.
National Metal Molding Co.
Western Conduit Co.

Conduits, Underground.
Camp Co., H. B.
Fibre Conduit Co.
Gest, G. M.
Johns-Manville Co., H. W.
Michigan Pipe Co.
McRoy Clay Works.
National Conduit & Cable Co.

Connections and Terminals.
Elec'l Engineers Equip. Co.

Controllers.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Monitor Controller Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Conveying Machinery. (Coal, Ashes, Etc.)
American Bridge Co.
Green Engineering Co.
Morse Chain Co.
Northern Eng. Works.

Cord Adjusters.
American Vul. Fibre Co.
Diamond State Fibre Co.

Cord, Arc Lamps.
Samson Cordage Works.

Cord, Flexible.
American Electrical Works.
Belden Mfg. Co.

Cord, Trolley.
Samson Cordage Works.

Couplings, Flexible.
Bruce-Macbeth Engine Co.

Crane Motors.
Crocker-Wheeler Co.
Westinghouse Elec. & Mfg. Co.

Cranes, Traveling.
American Bridge Co.
Maris Bros.
Northern Engineering Works.

Cross-Arms.
American Bridge Co.
Barnes, Lindsley Mfg. Co.
Riter-Conley Co.
Thomas & Sons, R.
Western Elec. Co.

Cutouts.
D. & W. Fuse Co.
G. & W. Electric Specialty Co.
Metropolitan Eng'g Co.

Dies.
Col's Die, Tool & Machine Co.

Drills, Brick.
Hubbard & Co.

Drills, Electric.
Barnes Co., W. F. & Jno.
Electric Tachometer Co.
U. S. Elec'l Tool Co.

Dynamos and Motors.
Allis-Chalmers Mfg. Co.
Burke Electric Co.
C. & C. Elec. & Mfg. Co.
Century Electric Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Eck Dynamo Motor Co.
Electric Machinery Co.
Electro-Dynamic Co.
Emerson Electric Mfg. Co
Engbergs Elec. & Mech. Wks
Fort Wayne Electric Works.
General Electric Co.
Gregory Electric Co.
Hallberg, J. H.
Kimble Electric Co.
Lincoln Elec. Co.
Northwestern Elec. Co.
Peerless Electric Co.
Reliance Elec. & Eng. Co.
Strelinger Co., Chas. A.
Wagner Electric Co.
Westinghouse Elec. & Mfg. Co.

Electromagnets.
Acme Wire Co.
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.
Sundh Electric Co.

Engineers, Consulting.
(See Directory of Engineers.)

Engineers, Contracting.
(See Directory of Engineers.)

Engines, Gas and Gasoline.
Allis-Chalmers Mfg. Co.
Bruce-Macbeth Engine Co
Carlisle & Finch Co.
General Elec. Co.
Strelinger Co., Chas. A.
Westinghouse Mach. Co.

Engines, Oil.
Busch-Sulzer Bros.
Lyons Atlas Co.
McIntosh & Seymour Corp.

Engines, Steam.
Allis-Chalmers Mfg. Co.
Buckeye Engine Co.
McIntosh & Seymour Corp
Murray Iron Works.
Westinghouse Mach. Co.

Experimental Apparatus.
Biddle, James G.
Esterline Co.
Machado & Roller.

Fan Motors.
Adams-Bagnall Elec. Co.
Diehl Mfg. Co.
Eck Dynamo & Motor Co.
Emerson Electric Mfg Co
Fort Wayne Electric Works.
General Electric Co.
Peerless Elec. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co

Fans (Exhaust and Ventilating).
Crocker-Wheeler Co.
Diehl Mfg. Co.
Emerson Elec. Mfg. Co.
Kimble Elec. Co.
Westinghouse El. & Mfg. Co.

Fibre (See Insulating Material).
American Vul. Fibre Co.
Continental Fibre Co.
Diamond State Fibre Co.
Fibre Conduit Co.
Johns-Manville Co., H. W.

Field Coil Pads.
Mass Chemical Co.
Walpole Tire & Rubber Co.

Financial.
Coal & Iron National Bank.
Electric Bond & Share Co.

Fire Extinguishers.
Pyrene Mfg. Co.

Fixtures, Electric and Gas.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.
Johns-Manville Co., H. W.

Flashers.
Campbell Electric Co.

Flashlights.
Electric Operations Corp.

Friction Tape and Cloths.
Johns-Manville Co., H. W.
Massachusetts Chem. Co.
Walpole Tire & Rubber Co.

READY-REFERENCE INDEX

to products manufactured by advertisers in this issue of Electrical World

Fuses.
Chicago Fuse Mfg. Co.
Condit Elec. Mfg. Co.
D. & W. Fuse Co.
Daum Co., A. F.
Delta Star Elec. Co.
Economy Fuse & Mfg. Co.
General Electric Co.
Johns-Manville Co., H. W.
Metropolitan Eng'g Co.
Railway & Indus. Eng'g Co.
Western Elec. Co.

Fuses, Refillable.
Daum Co., A. F.
Economy Fuse Mfg. Co.
Johns-Manville Co., H. W.

Fuse Boxes.
(See Boxes, Fuse.)

Gauges, Recording.
Bristol Co.
Industrial Instrument Co.

Gauges, Water Column.
Jenkins Bros.

Gears.
Chicago Rawhide Co.
Diamond State Fibre Co.
New Process Gear Corp.

Glass.
Lippincott Glass Co.

Globes, Shades, Etc.
Faries Mfg. Co.
Lippincott Glass Co.

Graphite.
Dixon Crucible Co., Joseph.

Grinders, Electrically Driven.
U. S. Elec'l Tool Co.

Grounds, Etc.
Paragon Electric Co.

Guards, Inc., Lamps.
Hubbell, Inc., Harvey.
Matthews & Bro., Inc., W. N

Hair Dryers.
Shelton Elec. Co.

Hangers, Cable.
Condit Elec. Mfg. Co.
Matthews & Bro., Inc., W. N.

Head Gates.
American Bridge Co.

Heating Devices, Electric.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hughes Elec. Heating Co.
Simplex Electric Heating Co.
Western Elec. Co.
Westinghouse El. & Mfg. Co.

Heating, Steam.
American District Steam Co.

Hoists, Electrical and Steam.
Allis-Chalmers Mfg. Co.
Maris Bros.
Northern Engineering Works.

Ice Machines.
Carbondale Machine Co.
Johns-Manville Co., H. W.

Ignitors, Gas Engine.
Carlisle & Finch Co.

Indicator, Speed.
Biddle, James G.
Machado & Roller.

Injectors.
Jenkins Bros.

Instruments, Electrical.
Graphic.
Biddle, James G.
Bristol Co.
Esterline Co.
General Electric Co.
Keystone Electrical Inst. Co
Westinghouse El. & Mfg. Co.
Indicating.
Eldredge Elec. Mfg. Co.
Fort Wayne Electric Works...
General Electric Co.
Hoyt Elec'l Instru. Co.
Keystone Electrical Inst. Co.
Machado & Roller.
Roller-Smith Co.
Sangamo Electric Co.
Wagner Elec. Mfg. Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Instr. Co.
Integrating.
Biddle, James G.
Columbia Meter Co.
Duncan Electric Mfg. Co.
General Electric Co.
Sangamo Electric Co.
Westinghouse El. & Mfg. Co.
Scientific and Testing.
Biddle, James G.
Keystone Electrical Inst. Co.
Leeds & Northrup Co.
Matthews & Bro., Inc., W. N.
Metropolitan Engr'g Co.

Insulating Cement.
Massachusetts Chem. Co.
Walpole Tire & Rubber Co.

Insulating Machinery.
American Ins. Mach'y Co.
New England Butt Co.

Insulating Material.
China and Porcelain.
Colonial Sign and Ins. Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Pittsburgh H. V. Ins. Co.
Star Porcelain Co.
Thomas & Sons Co., R.
Compounds, Paints and Varnishes.
Diamond State Fibre Co.
Electric Cable Co.
General Bakelite Co.
General Electric Co.
Massachusetts Chem. Co.
Walpole Tire & Rubber Co.
Composition, Cloth and Paper.
Diamond State Fibre Co.
Walpole Tire & Rubber Co.
Fibre.
Continental Fibre Co.
Diamond State Fibre Co.
Formica Insulation Co.
Johns-Manville Co., H. W.
Massachusetts Chem. Co.
Lava.
Stewart Mfg. Co., D. M.
Mica.
Formica Insulation Co.
Mica Insulator Co.
Silk.
Ryle & Co., Wm.
Tape.
American Electrical Works.
Diamond State Fibre Co.
Johns-Manville Co., H. W.
Massachusetts Chem. Co.
Okonite Company, The.
Walpole Tire & Rubber Co.

Insulating Paper.
Diamond State Fibre Co.

Insulators.
China, Porcelain and Composition.
Anderson Mfg. Co., A. & J. M.
Colonial Sign & Ins. Co.
General Electric Co.
General Insulate Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Pittsburgh High Volt Ins. Co.
Star Porcelain Co.
Thomas & Sons Co., R.
Glass.
Hemingray Glass Co.
Locke Insulator Mfg. Co.

Insulator Clamps.
Elec'l Engineers Equip. Co.

Insulator Pins.
Thomas & Sons, R.

Jig & Fixture Work.
Col's Die, Tool & Machine Co.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Fort Wayne Electric Works.
General Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Flaming Arc.
General Electric Co.
Westinghouse El. & Mfg. Co.

Lamp Guards.
Hubbell, Inc., Harvey.

Lamps, Incandescent.
Boston Economy Lamp Div.
Cons. Elec. Lamp Co.
General Electric Co.
Independent Lamp & Wire Co.
Western Electric Co.
Westinghouse Lamp Co.

Lamps, Miniature.
General Electric Co.

Lamps, Portable.
Faries Mfg. Co.

Lamps, Replacers.
Matthews & Bro., Inc., W. N.

Lamps, Safety.
Concordia Safety Lamp Co.

Lamps, Turndown.
General Elec. Co.

Lathes.
Barnes Co., W. F. & Jno.

Lava.
(See Insulating Material, Lava.)

Lighting Companies.
Commonwealth Edison Co.

Lightning Arresters.
Delta Star Elec. Co.
General Electric Co.
Railways & Indus. Eng'g Co.
Westinghouse El. & Mfg. Co.

Line Material.
Anderson Mfg. Co., A. & J. M.
Archbold-Brady Co.
Elec'l Engineers Equip. Co.
G. & W. Elec. Specialty Co.
General Electric Co.
Johns-Manville Co., H. W.
Matthews & Bro., Inc., W. N.
Pacific Elec. & Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Linemen's Tools.
(See Tools, Linemen).

Linemen's Shields.
Matthews & Bro., Inc., W. N.

Lubricants.
Dearborn Chemical Co.
Dixon Crucible Co., Joseph.

Magnet Wire.
Acme Wire Co.
American Brass Co.
American Steel & Wire Co.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
D. & W. Fuse Co.
Independent Lamp & Wire Co.
Massachusetts Elec. Mfg. Co.
Western Electric Co.

Magnets.
Acme Wire Co.

Magnets, Lifting.
Electric Controller & Mfg. Co.
Cutler-Hammer Mfg. Co.

Mechanical Stokers.
Westinghouse Machine Co.

Medical Apparatus.
Manhattan Elec'l Supply Co
Pignolet, L. M.

Meter Dials.
Premier Metal Etching Co

Meter Testers.
States Company.

Mica.
Formica Insulation Co.
Mica Insulator Co.

Mining Machinery.
Allis-Chalmers Mfg. Co.
Crocker-Wheeler Co.
General Electric Co.

Molded Insulation.
Cutler-Hammer Mfg. Co.

Motors.
(See Dynamos and Motors.)

Moulded Insulation.
Cutler-Hammer Mfg. Co.

Name Plates.
Premier Metal Etching Co.

Nippers and Pliers.
Klein & Son, Mathias.
Osborne Co., C. S.
Smith & Hemenway Co.

Novelties, Electric.
Carlisle & Finch Co.

Oil, Cylinder.
(See Lubricants.)

Operators, Public Utilities.
Light & Development Co.

Ovens (Baking, Drying, Japanning.)
Oven Equipment Co.

Ozonizers.
Westinghouse El. & Mfg. Co.

Packing.
Jenkins Bros.

Panel Boards.
General Electric Co.
Metropolitan Eng'g Co.
Sterling Switchboard Co.
Trumbull Elec. Mfg. Co.
Westinghouse El. & Mfg. Co.

Penstock.
Portland Wood Pipe Co.

Photometer Standards.
Elec'l Testing Laboratories.

Pinions, Rawhide.
Chicago Rawhide Co.
New Process Gear Corp.

Pipe.
Michigan Pipe Co.
Portland Wood Pipe Co.

Pipe Fittings.
Best Mfg. Co.

Pipe Locators.
Matthews & Bro. Inc., W. N.

Piping Contractors.
Best Mfg. Co.

Platinum.
American Platinum Works.
Baker & Co., Inc.
Roessler & Hasslacher C. Co.

Plugs.
Condit Electrical Mfg. Co.
Hubbell, Inc., Harvey.
National Metal Molding Co.

Pole Erectors.
American Bridge Co.
Matthews & Bro., Inc., W. N.

Pole Line Hardware.
Hubbard & Co.
Matthews & Bro., Inc., W. N.
Western Elec. Co.

Poles.
Sand Point Lumber & Pole Co.
Western Electric Co.
Western Lumber & Pole Co.

Poles, Arc Lamp.
Electric Railway Equip. Co.
King Foundry Co.
Mott Iron Works, J. L.

Poles, Brackets, Pins, Etc.
Sand Point Lumber & Pole Co.
Western Electric Co.
Western LLumber & Pole Co.

Poles, Re-Enforcing.
Hubbard & Co.

Poles, Steel.
American Bridge Co.
Archbold-Brady Co.
Blaw Steel Cons. Co.
Franklin Steel Works.
Riter-Conley Co.
Scaife & Sons Co., Wm. B.

Porcelain. (See Insulating Material, China and Porcelain.)

Potentiometers.
Biddle, James G.
Leeds & Northrup Co.

Potheads.
Colonial Sign & Ins. Co.
Elec'l Engineers Equip. Co.
G. & W. Elec. Specialty Co.
Okonite Co., The.

Power Transmission Machinery.
Morse Chain Co.

Producers, Gas.
Westinghouse Machine Co.

Protective Devices.
Metropolitan Eng'g Co.

READY-REFERENCE INDEX

to products manufactured by advertisers in this issue of Electrical World

Pulleys.
Rockwood Mfg. Co.

Pumps, Centrifugal.
Allis-Chalmers Mfg. Co.

Pumps, Oil.
Ludlow Valve Mfg. Co.

Pumps, Steam.
Allis-Chalmers Mfg. Co.
Worthington, Henry R.

Push Buttons.
Manhattan Elec'l Supply Co.

Pyrometers.
Keystone Electrical Inst. Co.

Rail Bonds.
American Steel & Wire Co.
Condit Electrical Mfg. Co.
General Elec. Co.
Roebling's Sons Co., J. A.

Railway, Miniature.
Carlisle & Finch Co.

Receptacles. (See Sockets.)

Rectifiers.
General Electric Co.

Reels.
Hallberg, J. H.
Westinghouse Elec. & Mfg. Co.

Reflectors.
General Elec. Co.
Johns-Manville Co., H. W.

Refrigerating Machines.
Carbondale Machine Co.
Johns-Manville Co., H. W.

Relays, Thermal.
Baruch Electric & Controller Corp.

Repairing.
Commonwealth Edison Co.
Gregory Electric Co.

Resistance Units.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Ellcon Co.
General Elec. Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.
Wirt Co.

Resistance Wire. (See Wires, Resistance.)

Rheostats.
Biddle, James G.
Campbell Electric Co.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Monitor Controller Co.
Simplex Electric Heating Co.
Sundh Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Rosettes.
Hart Mfg. Co.
National Metal Molding Co.
Trumbull Electric Mfg. Co.

Sal Ammoniac.
Roessler & Hasslacher, C. Co.

Searchlights.
Carlisle & Finch Co.
General Elec. Co.

Second-hand Apparatus.
Archer & Baldwin.
Duzets & Sons.
Gregory Electric Co.
Jordan Bros.
MacGovern & Co.
Sachsenmaier & Co., Geo.
Wilson Machinery Co., H. R.

Shade Holders.
Hubbell, Inc., Harvey.

Shades, Tin.
Ostrander Sign & Ins. Co.

Sheet Metal.
Am. Sheet & Tin Plate Co.

Sheets, Electrical.
Am. Sheet & Tin Plate Co.

Signs.
Colonial Sign & Ins. Co.

Signs, Electric.
Colonial Sign & Ins. Co.

Slate.
Davis Slate & Mfg. Co.

Sleeving, Braided.
Belden Mfg. Co.

Sockets & Receptacles.
Benjamin Elec. Mfg. Co.
Cutler-Hammer Mfg. Co.
General Elec. Co.
Hubbell, Inc., Harvey.
Johns-Manville Co., H. W.
National Metal Molding Co.
Ostrander & Co., W. R.

Sockets, Turndown.
General Electric Co.
Wirt Co.

Solder.
Belden Mfg. Co.

Soldering Flux.
Blake Signal Mfg. Co.
Condit Electrical Mfg. Co.

Soldering Irons.
Simplex Electric Heating Co.

Solenoids.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Elec. Co.
Sundh Electric Co.
Ward Leonard Electric Co.

Special Machinery.
Torrington Mfg. Co.

Speedometers.
Keystone Elec'l Inst. Co.

Splicing Compound.
Mass. Chemical Co.
Walpole Tire & Rubber Co.

Springs.
American Steel & Wire Co.
Barnes Co., The Wallace.
Cary Spring Works.
Cook Springs Co.

Stacks, Steel Smoke.
American Bridge Co.

Stage Lighting Apparatus.
Campbell Electric Co.
Condit Electrical Mfg. Co.

Staples.
American Steel & Wire Co.
Blake Signal & Mfg. Co.

Starters.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.

Steel Buildings.
Blaw Steel Constr. Co.

Stokers.
American Engineering Co.
Green Eng'g Co.
Sanford Riley Stoker Co.

Stoves, Electric.
Cutler-Hammer Mfg. Co.
General Elec. Co.
Hughes Elec. Heating Co.
Simplex Electric Heating Co.

Stranding Machinery.
Torrington Mfg. Co.

Sub-Stations, Outdoor.
Railway & Indus. Eng'g Co.

Supplies (Electric Railway.)
General Electric Co.
Johns-Manville Co., H. W.
Western Electric Co.

Supplies, Electrical.
General Electric Co.
Hart Mfg. Co.
Manhattan Elec. Supply Co.
Ostrander & Co., W. R.
Western Electric Co.

Supplies (Telephone).
Western Electric Co.

Switchboard Mats.
Mass. Chemical Co.
Walpole Tire & Rubber Co.

Switchboard Supplies.
Condit Electrical Mfg. Co.
Elec'l Engineers Equip. Co.
General Elec. Co.
Machado & Roller.
West. Elec. & Mfg. Co.

Switchboards.
Allis-Chalmers Mfg. Co.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
General Electric Co.
Machado & Roller.
Metropolitan Eng'g Co.
Sterling Switchboard Co.
Trumbull Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switches.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Elec'l Engineers Equip. Co.
General Elec. Co.
K. P. F. Elec. Co.
Metropolitan Eng'g Co.
Pacific Elec. Mfg. Co.
Railway & Indus. Eng'g Co.
Sundh Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches, Fuse.
General Electric Co.
Matthews & Bro., Inc., W. N.
Pacific Elec. Mfg. Co.

Switches, Knife.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
General Electric Co.
Trumbull Elec. & Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Oil.
Condit Electrical Mfg. Co.
General Electric Co.
Pacific Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Pole Top.
Delta-Star Elec. Co.
Elec'l Engineers Equip. Co.
General Electric Co.
K. P. F. Elec. Co.
Pacific Elec. Mfg. Co.

Switches, Remote Control.
General Electric Co.

Switches, Snap & Push Button.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.

Switches, Time.
Anderson Mfg. Co., A. & J. M.
Campbell Electric Co.
Paragon Elec. Co.

Tachometers.
Biddle, James G.
Electric Tachometer Co.
Industrial Instrument Co.
Keystone Elec'l Inst. Co.
Machado & Roller.

Taps & Dies.
Carpenter Tap & Die Co., J. M.

Telephones.
Manhattan Elec'l Supply Co.
Western Electric Co.

Terminals and Blocks.
Eureka Supply Co.

Testing Apparatus.
American Transformer Co.
Biddle, James G.
Esterline Co.
Keystone Electrical Inst. Co.
Leeds & Northrup Co.
Machado & Roller.
Matthews & Bro., Inc., W. N.

Testing, Electrical.
Elec. Testing Laboratories.

Testing Laboratories.
Elec. Testing Laboratories.

Theater Dimmers.
Cutler-Hammer Mfg. Co.
General Electric Co.
Simplex Elec. Heating Co.
Ward Leonard Electric Co.

Thermometers.
Industrial Instrument Co.
Keystone Electrical Inst. Co.
Leeds & Northrup Co.

Tools.
Osborne Co., C. S.

Tools, Construction
Klein & Sons, Mathias.

Tools, Linemen's.
Klein & Sons, Mathias.
Western Elec. Co.

Towers, Transmission.
American Bridge Co.
Archbold-Brady Co.
Blaw Steel Cons. Co.

Transformers.
Adams-Bagnall Elec. Co.
Allis-Chalmers Mfg. Co.
American Transformer Co.
Campbell Electric Co.
Crocker-Wheeler Co.
Duncan Elec. Mfg. Co.
Enterprise Elec. Co.
Esterline Co.
Fort Wayne Electric Works.
General Electric Co.
Halberg, J. H.
Kuhlman Electric Co.
Metropolitan Eng'g Co.
Pittsburgh Transformer Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Inst. Co.

Transformers, Bell Ringing.
Pittsburgh Transformer Co.
Westinghouse Elec. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Mfg. Co.
General Elec. Co.
Westinghouse Machine Co.

Vacuum Cleaners.
Western Elec. Co

Valve Disks.
Diamond State Fibre Co.
Jenkins Bros.

Valves.
Best Mfg. Co.
Jenkins Bros.
Pittsburgh F. V. & C. Co.
Sundh Electric Co.

Valves, Cylinder Relief.
Ludlow Valve Mfg. Co.

Valves, Pump.
Jenkins Bros.

Vibrators.
Shelton Elec. Co.

Washing Machines, Electric.
Automatic Elec. Washer Co.
Western Elec. Co.

Water Wheels and Turbines.
Allis-Chalmers Mfg. Co.
Leffel & Co., James
Pelton Water Wheel Co.
Smith Co., S. Morgan
Trump Mfg. Co.

Water Wheel Governors.
Lombard Governor Co.
Ludlow Valve Mfg. Co.
Woodward Governor Co.

Wattmeters, Watt-Hour Meters. (See Instruments, Electrical.)

Welding Apparatus.
C. & C. Elec. & Mfg. Co.

Winding Machinery.
New England Butt Co.

Wires, Resistance.
Belden Mfg. Co.
Driver-Harris Wire Co.

Wires and Cables.
Acme Wire Co.
Amer. Brass Co.
Amer. Electrical Works.
Amer. Steel & Wire Co.
Atlantic Ins. Wire & Cable Co
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
Bridgeport Brass Co.
Colyer Insulated Wire Co.
D. & W. Fuse Co.
Detroit Ins. Wire Co.
Driver-Harris Wire Co.
Electric Cable Co.
General Electric Co.
Independent Lamp & Wire Co.
Indiana Rub. & Ins. Wire Co.
Kerite Ins. Wire & Cable Co.
Lowell Ins. Wire Co.
Massachusetts Elec. Mfg. Co.
Moore, A. F.
National Conduit & Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Company, The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Rome Wire Co.
Safety Ins. Wire & Cable Co.
Simplex Wire & Cable Co.
Western Electric Co.

Wood Pipe.
Portland Wood Pipe Co.

X-Ray Apparatus.
Campbell Electric Co.

ALPHABETICAL INDEX TO ADVERTISEMENTS

NOTICE TO ADVERTISERS:

Printing begins on Friday of each week.
Changes of copy received up to 10 A. M. Friday will appear in the issue of the following week, but no proofs can be submitted for OK before publication.
New Advertisements (not changes of copy) received up to Tuesday noon can appear in the issue of that week, but no proofs can be shown.
If proofs before printing are required changes of copy and copy for new advertisements must be in our hands two weeks in advance of the date of publication.

Abbott & Eaton 68
Acme Wire Co. 44
Adams-Bagnall Elec. Co. 21
Allis-Chalmers Mfg. Co. 40
Aluminum Co. of America 43
American Brass Co. 43
American Bridge Co. 38
American District Steam Co. 68
American Electrical Works ..... BC
American Engineering Co. 76
American Insulating Mach. Co. 46
American Platinum Works 50
American Sheet & Tin Plate Co. 51
American Steel & Wire Co. 37
American Transformer Co. 53
American Vulcanized Fibre Co. 45
Anderson Mfg. Co., A. & J. M. 52
Andrews, E. J. 68
Archbold-Brady Co. 46
Archer & Baldwin 71
Arnold Co. 68
Atlantic Ins. Wire & Cable Co. 47
Automatic Elec. Washer Co. 58

Babcock & Wilcox Co. 61
Baehr, William A. 68
Baker & Co., Inc. 48
Barnes Lindsley Mfg. Co. 53
Barnes Co., Wallace 54
Barnes Co., W. F. & Jno. 60
Barstow & Co., W. S. 68
Baruch Electric Controller Corp. 53
Belden Mfg. Co. 46
Benedict & Burnham Mfg. Co. 43
Benjamin Electric Mfg. Co. 55
Best Mfg. Co. 64
Biddle, James G. 20
Blake Signal & Mfg. Co. 45
Blaw Steel Const. Co. 49
Boston Economy Lamp Div. 59
Bridgeport Brass Co. ..... BC
Bristol Co. ..... BC
Brooke, Homer 68
Bruce-Macbeth Engine Co. 67
Buckeye Engine Co. 67
Burke Electric Co. 61
Busch-Sulzer Bros.-Diesel Eng. Co. 67
Byllesby & Co., H. M. 68

C & C Elec. & Mfg. Co. 63
Camp Co., H. B. 48
Campbell Electric Co. 58
Carbondale Machine Co. 67
Card Index 62, 69
Carlisle & Finch Co. 59
Carpenter Tap & Die Co., J. M. 62
Cary Spring Works 52
Century Elec. Co. 63
Chicago Fuse Mfg. Co. 47
Chicago Rawhide Mfg. Co. 44
Clark, Walter G. 68
Coal & Iron National Bank 67
Collyer Insulated Wire Co. ..... BC
Colonial Sign & Ins Co. 53
Col's Die Tool & Mach. Co. 51
Columbia Meter Co. 19
Commonwealth Edison Co. 71
Concordia Safety Lamp Co. 57
Condit Elec'l Mfg. Co. 21
Consolidated Electric Lamp Co. 55
Continental Fibre Co. 53
Cook Spring Co. 52
Cooper, Hugh L. 68
Cope, T. J. 58
Cravath, J. R. 68
Crocker-Wheeler Co. 58
Cutler-Hammer Mfg. Co. 5

D & W Fuse Co. 43
Daum & Co., A. F. 43
Day & Zimmermann 68
Davis Slate Mfg. Co. 47
Dearborn Chemical Co. 61
Delta Star Elec. Co. 47
Detroit Ins. Wire Co. ..... BC
Diamond State Fibre Co. 47
Diehl Mfg. Co. 59
Directory of Engineers 68, 69
Dixon Crucible Co., Joseph 66
Dodge Kern 68
Driver-Harris Wire Co. 45
Duncan Elec. Mfg. Co. 53
Duzets & Son 71

Eck Dynamo & Motor Co. 62
Economy Fuse & Mfg. Co. 16
Edison Storage Battery Co. 10
Eldredge Elec. Mfg. Co. 58
Electric Bond & Share Co. 66
Electric Cable Co. 50
Electric Controller & Mfg. Co. 55
Electric Machinery Co. 63
Electric Railway Equip. Co. 57
Electric Storage Battery Co. 60
Electric Tachometer Co. 56
Electrical Engineers Equip. Co. 39
Elec. Testing Laboratories 51, 68
Electrical World 3, 35
Electro Dynamic Co. 58
Ellcon Co., The 4
Emerson Elec. Mfg. Co. 59
Engbergs Elec. & Mch. Works 69
Engineers, Directory of 68, 69
Enterprise Electric Co. 50
Esterline Co. 49
Eureka Supply Co. 58

Fahnestock Electric Co. 54
Fargo Engineering Co. 68
Faries Mfg. Co. 14
Fibre Conduit Co. 52
Ford, Bacon & Davis 68
Formica Insulation Co. 66
Forstall & Robinson 68
Fort Wayne Electric Works 75
Fowle, Frank F. 68
Franklin Steel Works 36

G & W Elec. Spec. Co. 49
General Bakelite Co. 44
General Electric Co. 12, 24, 25
Gest, G. M. 55
Gould Storage Battery Co. 46
Graves Engineering Co., Inc. 68
Green Engineering Co. 65
Gregory Electric Co. 70
Greims Corp., H. E. 68

Hallberg, J. H. 62
Hart Mfg. Co. 15
Hemingray Glass Co. 55
Hemming Mfg. Co. 54
Hess-Bright Mfg. Co. 51
Holmes Fibre Graphite Co. 51
Hoyt Elec. Ins. Works 56
Hubbard & Co. 19
Hubbell, Harvey, Inc. 22
Hughes Elec. Heating Co. 40

Imperial Porcelain Works 50
Independent Lamp & Wire Co. 38
Indiana Rub. & Ins. Wire Co. 26
Industrial Instrument Co. ..... BC

Jackson, D. C. & W. B. 68
Jackson Co., W. A. 68
Jeandron, W. J. 61
Jenkins Bros. ..... BC
Jonhs-Manville Co., H. W. 17
Jordan Bros. 59

Kerite Ins. Wire & Cable Co. 1, 26
Kerry & Chase, Ltd. 68
Keystone Elec'l Instrument Co. 56
Kimble Electric Co. 60
King Foundry Co. 57
Klein & Sons, Mathias 49
Kuhlman Elec. Co. 48
K. P. F. Elec. Co. 54

Le Carbone Co. 61
Leeds & Northrup Co. 14
Leffel & Co., James 64
Light & Development Co. 66
Lincoln Elec. Co. 63
Lippincott Glass Co. 57
Locke Insulator Mfg. Co. 36
Lombard Governor Co. 64
Lowell Ins. Wire Co. 46
Ludlow Valve Mfg. Co. 64
Lyons Atlas Co. 66

MacGovern & Co. 72
Machado & Roller 19
Manhattan Electrical Supply Co. 54
Maris Bros. 65
Massachusetts Elec. Mfg. Co. ..... BC
Massachusetts Chemical Co. 45
Matthews & Bro., Inc., W. N. 9, BC
Maxim, Hiram Percy 68
McGill Mfg. Co. 58
McGraw-Hill Book Co., Inc. 74
McIntosh & Seymour Corp. 65
McLennan & Co., K. 60
McMeen & Miller 68
McNeil, Ralph 68
McRoy Clay Products 48
Merchants Engineer's Corp. 18
Mershon, Ralph D. 69
Metropolitan Eng. Co. 23
Mica Insulator Co. 46
Michigan Pipe Co. 58
Moloney Electric Co. 18
Monitor Controller Co. 48
Moody Engineering Co. 69
Moore, Alfred F. 45
Moore & Co., Edgar M. 71
Morgan Crucible Co., Ltd. 39
Morse Chain Co. 81
Mott Iron Works, J. L. 57
Mueller & Co. 49
Murray Iron Works 65

National Conduit & Cable Co. 47
National Metal Molding Co. 16
Neall, N. J. 69
Neiler, Rich & Co. 69
New England Butt Co. 46
New Process Gear Corporation 42
New Process Specialty Co. 48
New York Ins. Wire Co. ..... BC
Norma Co. of America 62
Northern Engineering Works 67
Northwestern Elec. Co. 60
Norton & Bird 69
Nungesser Carbon & Bty. Co. 51

Okonite Co., The ..... 26, FC
Osborne & Co., C. S. 50
Ostrander & Co., W. R. 58
Oven Equip. & Mfg. Co. 48

Pacific Elec. Mfg. Co. 49
Paragon Elec. Co. 49
Peerless Elec. Co. 23
Pelton Water Wheel Co. 55
Petschel Storage Battery Co., Inc. 54
Phillips Ins. Wire Co. ..... BC
Pignolet, Louis M. 56
Pillsbury, Charles L. 69
Pittsburgh High Voltage Ins. Co. 55
Pittsburgh Transformer Co. 48
Pittsburgh Valve F. & C. Co. 69
Portland Wood Pipe Co. 67
Premier Metal Etching Co. 58
Publisher's Page 35
Pyrene Mfg. Co. 50

Railway & Industrial Eng'g Co. 43
Reed, W. Edgar 69
Reliance Elec. & Eng. Co. 41
Ridgway Dyn. & Eng. Co. 41
Rockwood Mfg. Co. 11
Roebling's Sons Co., John A. 44
Roessler & Hasslacher Ch. Co. 54
Roller-Smith Co. 19
Rome Wire Co. ..... 45, BC

Sachsenmaier & Co., Geo. 71
Safety Ins. Wire & Cable Co. 7
Samson Cordage Works 52
Sanderson & Porter 69
Sandpoint Lumber & Pole Co. 53
Sanford Riley Stoker Co. 65
Sangamo Electric Co. 8
Sargent & Lundy 69
Scaife & Sons Co., Wm. B. 49
Scofield Eng'g Co. 69
Searchlight Section 70, 73
Shelton Elec. Co. 59
Simplex Electric Heating Co. 37
Simplex Wire & Cable Co. 47
Smith Co., S. Morgan 64
Stackpole Carbon Co. 61
Star Porcelain Co. 20
States Company 56
Sterling Switchboard Co. 54
Steward Mfg. Co., D. M. 56
Stone & Webster Eng'g Corpn. 69
Storage Battery Supply Co. 51
Strelinger Co., Chas. A. 65
Sundh Electric Co. 17

Taylor, John B. 69
Thomas, Percy H. 69
Thomas & Sons Co., R. 52
Torrington Mfg. Co. 47
Transmission Eng'g Co. 43
Trumbull Electric Mfg. Co. 15
Trump Mfg. Co. 64

Underwriters' Laboratories, Inc. 69
U. S. Electric Tool Co. 62

Wagner Electric Mfg. Co. 13
Walpole Tire & Rubber Co. 45
Ward Leonard Elec. Co. 51
Western Conduit Co. 52
Western Electric Co. 6
Western Lumber & Pole Co. 53
Westinghouse El. & Mfg. Co. 82
Weston Elec'l Instrument Co. 2
White Companies, J. G. 69
Wilson Machinery Co., Harold R. 71
Williams, Gardner S. 69
Wirt Co. 48
Woodmansee & Davidson 69
Woodward Governor Co. 65
Worthington, Henry R. 66

It's up to You!

It's up to you to see that the connecting link between YOUR motor and YOUR CUSTOMER'S machine is such as will insure:

(1) Highest Motor Efficiency.
(2) Minimum Maintenance and Repair.
(3) Maximum Machine Production.

(1) The percentage of power *developed* by the electric motor is not motor efficiency to the machine owner. He judges your motor by the power available for use in his machine.

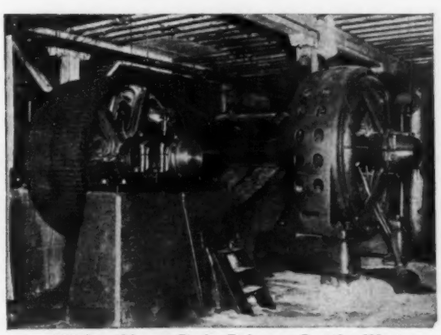
No other transmission system approaches the almost 99% *sustained for years efficiency* of MORSE Silent Chains.

(2) The question of maintenance and repair in the selection of a transmission system is not for the drive alone, but also for the motor and machine.

MORSE Silent Chains protect both motor and machine by entirely eliminating tooth hammering, incident to the use of gearing, reducing journal friction to a minimum and, being run slack, absorbing all shocks and jars.

(3) Power regulates production. Only by making the maximum amount of power available for use in the machine is maximum production possible.

You lose some power in any transmission, but you can't expect to do better than the almost 99% *sustained for years efficiency* of MORSE Silent Chains.



500 h.p. Morse Chain Drive at Seattle, Wash.

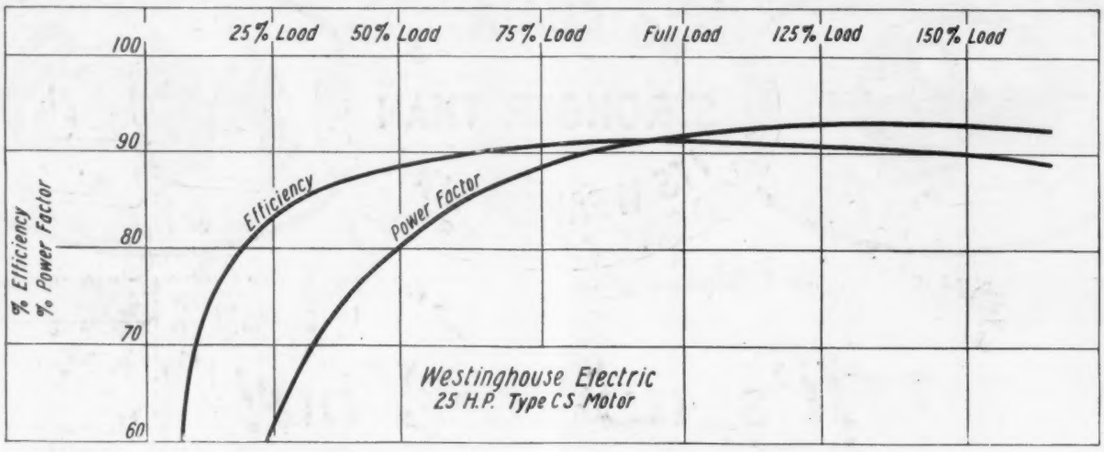
Haven't you one or more places where you could afford a better drive, where you could now try out a MORSE Silent Chain? Why not do it now, while we can offer special inducements in the way of price and delivery?

Write us.

Morse Chain Company
Ithaca, N. Y.

Largest exclusive manufacturers of silent chain power transmission in the world. Offices in important cities.

B-62



The New Westinghouse Electric Induction Motors

(Type CS) have

Unusually High Efficiency

In laying out the designs for these motors, the Westinghouse Electric & Mfg. Company determined that, in addition to their advantageous mechanical features,

1. They must have higher efficiency and power factor than any other line of motors on the market.

2. The efficiency must be high, not only at full load but throughout the entire range from 25 to 150 per cent load because industrial motors frequently operate at fractional or overloads. The successful solution of these problems is shown by the curves above, which are typical for the CS line. Ask the Westinghouse representative to give you the figures for the motors in which you are interested.

The high efficiency and power factor of these motors, combined with their great mechanical strength, indestructible rotors, dust-proof bearings, open stator slots, and wide, permanently adjusted air gaps, make them **the most serviceable induction motors ever produced.**

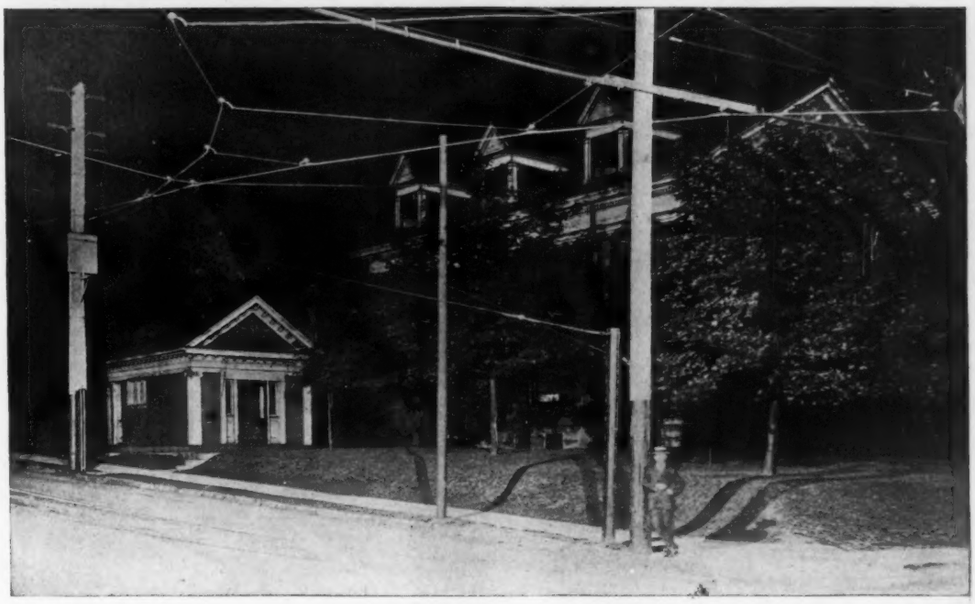
Made in all commercial sizes and speeds for all commercial polyphase circuits and for all constant speed service. Send for full information.

Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

10 Horsepower.

Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Bluefield, W. Va.
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
Charleston, W. Va
Charlotte, N. C.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
Dayton, Ohio
Denver, Colo.
Detroit, Mich.
Indianapolis, Ind.
Joplin, Mo.
Kansas City, Mo.
Knoxville, Tenn.
Louisville, Ky.
Los Angeles, Cal.
Memphis, Tenn.
Milwaukee, Wis.
Minneapolis, Minn.
New Orleans, La.
New York, N. Y.
Omaha, Neb.
Philadelphia, Pa.
Pittsburgh, Pa.
Portland, Ore.
Richmond, Va.
Rochester, N. Y.
St. Louis, Mo.
Salt Lake City, Utah
San Francisco, Cal.
Seattle, Wash.
Syracuse, N. Y.
Toledo, Ohio
Washington, D. C.
Wilkes-Barre, Pa.

25 Horsepower.



Street in Bellevue, Pa., lighted by Westinghouse Flame Carbon Lamps.

This is not a daylight view. The photograph was taken at night, but it looks like daytime, because the street is lighted by

Westinghouse Flame Carbon Arc Lamps

The intense, yet soft, steady light of these lamps is a revelation to any one who has not seen them in operation. And they are economical to maintain and operate. Service tests have demonstrated their long life per trim, 100 to 125 hours.

Besides their success in the lighting of streets these lamps are equally efficient for the illumination of parks and public squares, railroad yards and terminals, wharfs and large interiors. Carbons are furnished to give white or yellow light, as the conditions require.

Westinghouse Electric & Manufacturing Co.

East Pittsburgh, Pa.

Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Bluefield, W. Va.
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
Charleston, W. Va.
Charlotte, N. C.
Chicago, Ill.
Cincinnati, Ohio.
Cleveland, Ohio.
Columbus, Ohio.
*Dallas, Texas
Dayton, Ohio.
Denver, Colo.
Detroit, Mich.
*El Paso, Texas
*Houston, Texas
Indianapolis, Ind.
Joplin, Mo.
Kansas City, Mo.
Louisville, Ky.
Los Angeles, Cal.
Memphis, Tenn.
Milwaukee, Wis.
Minneapolis, Minn.
New Orleans, La.
New York, N. Y.
Omaha, Neb.
Philadelphia, Pa.
Pittsburgh, Pa.
Portland, Ore.
Rochester, N. Y.
St. Louis, Mo.
Salt Lake City, Utah
San Francisco, Cal.
Seattle, Wash.
Syracuse, N. Y.
Toledo, Ohio.
Washington, D. C.
*W. E. & M. Co. of Texas.

American Electrical Works
PHILLIPSDALE, R. I.

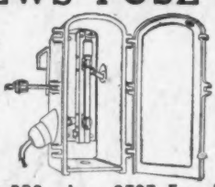
Bare and Insulated Electric Wire
Electric Light and Line Wire
Railway Feeder and Trolley Wire
Galvanized Iron Wire and Strands

NEW YORK OFFICE, 165 Broadway
CHICAGO OFFICE, 112 West Adams St.
BOSTON OFFICE, 176 Federal St.
CINCINNATI OFFICE - Traction Building
MONTREAL

1870 EUGENE F. PHILLIPS AMERICAN ELECTRICAL WORKS 1882

FOXBORO
TRADE MARK
INSTRUMENTS
For Pressure—Temperature—Speed—Time and Flow are Simple—Accurate—Durable. Specified by Leading Engineers. Send for Bulletin No. AC74.
The Industrial Instrument Company
THE FOXBORO COMPANY
FOXBORO, MASS., U.S.A.
New York Chicago

MATTHEWS FUSE SWITCH



instantly "kills" the section in trouble, but nothing and nobody else. Combines fuse block and primary line disconnecting switch. Recommended for their safety by largest liability companies in the world and by largest light and power companies for their efficiency.

W. N. MATTHEWS & BRO., Inc., 3727 Forest Pk. Boul., St. Louis
Canadian Distributors, Northern Electric Co., Ltd., Montreal, Halifax, Toronto, Winnipeg, Regina, Calgary, Edmonton, Vancouver.

I.X.L. Wires and Cables

Weatherproof, Slow Burning, Slow Burning Weatherproof, Damp Proof Office, Annunciator, Rubber Covered, Lamp Cords, Telephone Wires.
Write for prices.
Collyer Insulated Wire Co., Pawtucket, R. I.

Bare and Tinned Copper Wire
Magnet Wire, Rubber Covered Wire
Rome Wire Co., Rome, N. Y.

For 30 Years the Standard

"O. K." Weatherproof Wire
"Parac" Rubber Wire
Bare Copper Wire

Slow Burning Weatherproof
Railway Feeder Wire
Slow Burning Wire

PHILLIPS INSULATED WIRE CO., Pawtucket, R. I.
Mexican Branch: Cia. Mexicana de Alambre "Phillips," Mexico City

Jenkins Bros. Pump Valves possess maximum toughness and wear resisting qualities with sufficient elasticity to insure tightness. Different compounds meet all operating conditions. Our factory is prepared to furnish promptly in any size, shape or compound.
Jenkins Bros. New York Boston Philadelphia Chicago

Get Your Copy of the New Price Booklet

RAVEN **CORE**

Rubber Covered Wire
Ask for Booklet 23-W
NEW YORK INSULATED WIRE CO., NEW YORK
Agencies and Branches
CHICAGO BOSTON SAN FRANCISCO

Practical experience shows that
"Phono-Electric"
Trolley Wire is the most economical wire to use. Write us.
BRIDGEPORT, BRASS CO.
BRIDGEPORT, CONN.

CONTINUOUS RECORDS
are automatically furnished in ink on paper charts throughout the day and night by
Bristol's Recording Instruments
for pressure, temperature, electricity, time, motion, speed, etc. Bristol recorders are unique in their extreme simplicity.
Write for Bulletin L-131
THE BRISTOL CO., Waterbury, Conn.

"DETROIT"
RUBBER COVERED
WIRES
U.S. PATENT OFFICE
Made by Detroit Insulated Wire Company, Detroit

Quality Magnet Wire
Massachusetts MAGNET WIRE
COTTON SILK ENAMEL
Massachusetts Electric Mfg. Co. WEST LYNN, MASS.